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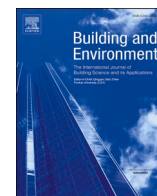
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Ten questions concerning age-friendly cities and communities and the built environment

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ABSTRACT

The development of ‘age-friendly cities’ has become a major area of work in the field of ageing and the built environment. This movement is driven by the observation that cities are home to an ever-increasing ageing population. Over the past decade, a multitude of age-friendly initiatives have been developed with the aim of making physical and social environments more favourable for older people’s well-being, health and ability to live in the community. This article explores ten key questions associated with the age-friendly cities and communities’ movement, with a particular focus on the built environment. It provides an overview of the history of the age-friendly cities’ movement and the underlying models, the aspects of the built environment that are relevant for age-friendly cities, the ways age-friendliness can be evaluated, and the interactions between age-friendly cities initiatives and other strategic agendas such as smart cities. The paper concludes by discussing future perspectives and possible directions for further development of the age-friendly movement.

1. Introduction

Globally, populations are ageing. The majority of people now live in urban areas and will do so for the foreseeable future [1,2]. A significant minority of older people grow old in the urban environment. As reported by the Organisation for Economic Co-operation and Development, this equates to nearly 45% of older adults in its member states [1]. The combination of population ageing and urbanisation has led to the emergence of “urban ageing” as a domain of research in social and health sciences [2–7], which intersects with the field of geographical gerontology (for instance, Skinner et al. [8]) and environmental gerontology (for instance, Chaudhury and Oswald [9]). Urban ageing has ramifications that extend beyond the frontiers of these disciplines, including architecture, urban planning, real estate and engineering [7]. As Plouffe and Kalache [10] have rightfully concluded in their paper that the ever-increasing ageing of the population as well as urbanisation

are the pinnacle of successful human development. Older people represent a valuable resource in our societies, and therefore, cities are called upon to ensure older people’s inclusion and complete access to spaces, structures, and services [10]. These urban spaces, structures and services are ideally designed with the mindset of age-friendliness. The discourse and discussion on ageing and urbanisation within the design world (architects, artists and designers) has tended to stand apart from the language and thinking of age-friendly policy [11]. Handler [11] states that it is a paradox that engagement with the idea of age-friendliness remains limited whilst at the same time, issues that are related to design are often on the agenda of policy-led discussions.

This leads to several questions. For instance, how can cities be planned and designed for an ageing population? Should an integrated-oriented or a segregated-oriented planning strategy be applied and rolled out? Decisions are informed by how planners and policy-makers see the older population cohort [12]. An integrated approach follows the

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premise that the well-being and quality of life of older people could be best served through implementing an overall friendly community or city to all aspects of urban development. Additionally, each urban area has its own path in urbanisation history, and the time factor is an important matter when age-friendly city goals are pursued. There are four types of cities, which know different urbanisation stages (old cities vs young cities), which witness different levels of demographic transition (ageing fast vs ageing slowly). According to Chao [12], cities belonging to different types encounter distinct issues in terms of promoting an age-friendly built environment. Furthermore, each city should consider age-friendly strategies focusing on different spatial scales, namely -from large to small-at the city level (urban plan and policy), at the street and community level, and at the housing level (space and product) [12]. According to Scharlach [13], liveability could be the most elementary condition of age-friendliness, rising above age, and other characteristics. In short, such a liveable city should optimise opportunities for health, participation and security, and offer economical and fitting choices for housing and transportation.

With this in mind, the main question of this Ten Questions contribution is: What makes a city age-friendly when considering it from the perspective of the built environment? Asking oneself this question automatically leads to a myriad of other questions. What evidence is available to answer this question and support solutions taken in the built environment? What international initiatives are being conducted to make cities age-friendly? What are the best practices in this domain? How are older people involved in the design of the urban environment and policies regarding the built environment themselves?

This paper focuses on the importance of the built environment of age-friendly cities and communities, in particular, the aspects pertaining to housing, transport, the outdoor environment and technology.

1.1. Structure of the paper

This paper is structured as follows. Section 2 addresses ten questions focusing on age-friendly cities and communities and the built environment, these include: first, the background of the age-friendly cities and communities agenda; second, an overview of relevant domains for the built environment in terms of age-friendly solutions; third, the assessment of age-friendly cities and communities; and finally, an overview of the future perspectives of the age-friendly agenda for the domain of the built environment.

The questions are presented according to the following thematic structure:

- Background to the age-friendly movement (Q1, Q2);
- Age-friendly cities and housing, transport, the outdoor environment and technology (Q3, Q4, Q5, Q6);
- Assessing and measuring age-friendliness, learning from best practices, and obstacles to the age-friendly agenda (Q7, Q8, Q9);
- Future perspectives and agenda (Q10).

2. Ten questions (and answers) concerning age-friendly cities and communities and the built environment

2.1. "Question 1: What are age-friendly cities and communities and what is the history behind the movement?"

Answer: As outlined in detail by Buffel et al. [14], the theme of developing age-friendly cities and communities (AFCC) emerged from a series of policy initiatives set in motion by the World Health Organization (WHO) during the early 2000s. A leading idea running through these initiatives is related to 'active ageing' [14]. This notion was originally developed in 1999, during the United Nations' Year of Older People. It was further detailed by organisations as the European Union (EU) [15] and the WHO [16]. The WHO [16] stated that the term 'active' in active ageing reflects the idea that people should be able to continue

to participate in all spheres of life in old age – social, cultural, civic, spiritual and economic. Active ageing policies and programmes were regarded to require a diversity of interventions and actions to improve aspects of both the social and physical environment [14].

The ideas of active ageing were taken further in 2006. In that year, the WHO launched its 'Global Age-friendly Cities' project [17]. As part of this project, a number of focus groups with older people, carers, and service providers were conducted in 33 cities in 22 countries around the world, with the aim of identifying those factors that could make urban environments more 'age-friendly'. The project defined an 'age-friendly city' (AFC) as encouraging 'active ageing by optimising opportunities for health, participation and security in order to enhance quality of life as people age' [17, p.1]. The study resulted in a guide which identified the key characteristics of an AFC in terms of three main areas. These areas are service provision, the built environment, and social aspects [17]. This Global Age-Friendly Cities guide has since become the most frequently used document to promote and evaluate the goal of age-friendliness [18, 19].

The WHO launched the 'Global Network of Age-friendly Cities and Communities' (hereafter: Network) in 2010, in an attempt to stimulate the implementation of policy recommendations from the 2006 project. Since its inception, the Network has seen a rapid growth in membership, extending to more than 1100 cities and communities in 2021. The aim of the Network is to support its members in becoming more age-friendly. Through connecting cities and communities on a global level, the Network seeks to facilitate exchange of information, knowledge and experiences; inspire change; and support cities and communities in developing innovative solutions to make the environment more conducive to the needs of older people. Members of the Network include over 1100 cities and communities in 44 countries, as well as 14 Network affiliates, which include national or regional governments, civil society and research organisations from eleven countries that play a key role in supporting the Network's mission. Membership of the Network is not a designation but reflects a member's commitment to making progress towards the objective of becoming more age-friendly [20].

Between 2012 and 2015, the WHO conducted a series of literature reviews, expert consultation meetings and pilot studies which generated input from over 50 communities across 25 countries. This resulted in a report published in 2015 which set forth a framework and set of indicators to monitor and evaluate progress in improving the age-friendliness of urban environments [14,21]. Core indicators were structured around three key principles: equity (such as measured through comparisons between sub-groups and total population), accessibility of the physical environment, and inclusiveness of the social environment. Together, these indicators were seen to 'provide a starting point for developing a locally relevant but also externally comparable AFC indicator set' [21, p 25].

The WHO and the Network's efforts on AFCCs have been underwritten by a range of other age-friendly organisations, including international NGOs such as the International Federation on Ageing [5]. In North America these include the American Association of Retired Persons (AARP) Livable Communities, and the National Association of Area Agencies on Aging sponsored Livable Communities Initiative [14]. Age Platform Europe has taken up a leadership position in promoting the age-friendly agenda in Europe, for instance, through the campaign "Towards an Age-Friendly EU by 2020", as well as the AFE-INNOVNET Thematic Network on innovation for age-friendly environments (2014–2016). The latter is a group funded by the EU, which brought together a number of countries and cities across Europe [14].

A reflection on the Network was published by the WHO in 2018 [20]. This report features eleven case studies of cities within the Network and gives an overview of the progress that has been made over the last decade towards becoming more age-friendly. It also develops a vision for the future, highlighting the need for actions around reducing inequalities, making the Network more inclusive, building new partnerships and strengthening the evidence-base through co-production, by

working in partnership with older people and cities and communities to build instruments that work for them. Crucially, the report also highlights the WHO's continued commitment to the development of the Network as a priority within the 'Global Strategy and Action Plan on Ageing and Health' [22] and the related 'Decade of Action on Healthy Ageing' (2021–2030) [23].

2.2. "Question 2: Which models exist for age-friendly cities and communities, and how do they include the built environment?"

Answer: The most significant model for AFCC is the WHO's Age-Friendly Cities model, which was first presented in the document Global Age-Friendly Cities - A Guide [17]. This guide aimed to provide possible answers to questions on urban ageing and growing old in the city, and was based on the outcomes of a global research endeavour. One of the notions of the activities of the Network is that older people can stay independent and healthy for as long as possible if support is offered in a number of domains that pertain to every aspect of daily living. Based on this notion, the WHO [17] proposed eight domains in which cities would encounter challenges and in which actions are needed. These eight domains are (1) outdoor spaces and buildings; (2) transportation; (3) housing; (4) social participation; (5) respect and social inclusion; (6) civic participation and employment; (7) communication and information; and (8) community support and health services (Fig. 1). The accompanying Checklist of Essential Features of Age-Friendly Cities [24] contains an extensive overview of features, related to these eight domains, which are essential to an AFC.

In its essence, the built environment is covered by the domains of outdoor spaces and buildings; transportation; and housing. The WHO

also suggests that there are strong connections between the different aspects of urban living [17]. An AFC can only result from an integrated approach centred on how older people live. What is needed is the co-ordination of actions across various domains of city policy and services to enable and facilitate a mutual understanding, reinforcement and take-up [17]. Therefore, each domain of the model should not be treated or considered separately, as collective approaches and cross-departmental collaboration are encouraged to achieve the goals of the AFCC's agenda [12]. Relationships which are important in terms of the scope of this Ten Question paper are twofold. First, people's homes are located in areas safe from natural hazards. Also, dwellings should be close to services, other age cohorts and public attractions that stimulate the integration in the community, and keeping older people mobile and fit [17]. Second, transportation services and infrastructures should be consistently connected to opportunities for social, civic and economic participation, and health services [17].

These two relationships underline the importance of undertaking interdisciplinary action and collaboration between domains in order to achieve the goals of the age-friendly agenda. This importance is also recognised by the WHO itself. In 2018, the WHO published a number of knowledge gaps in terms of AFCC [20]; the largest of which is that the AFCs approach needs to reinforce its pivot multisectoral action that produces end-results which help lessen inequities. Or, in the words of the WHO, "guidance and tools are needed to support cities and communities to make decisions around which actions are most likely to ensure these outcomes and not leave any groups behind in the process of development" [20, p.18]. It is vital to be considerate of the fact that not only outdoor spaces and buildings, transportation and housing are relevant to the built environment. The success of the built environment in supporting AFCC relies

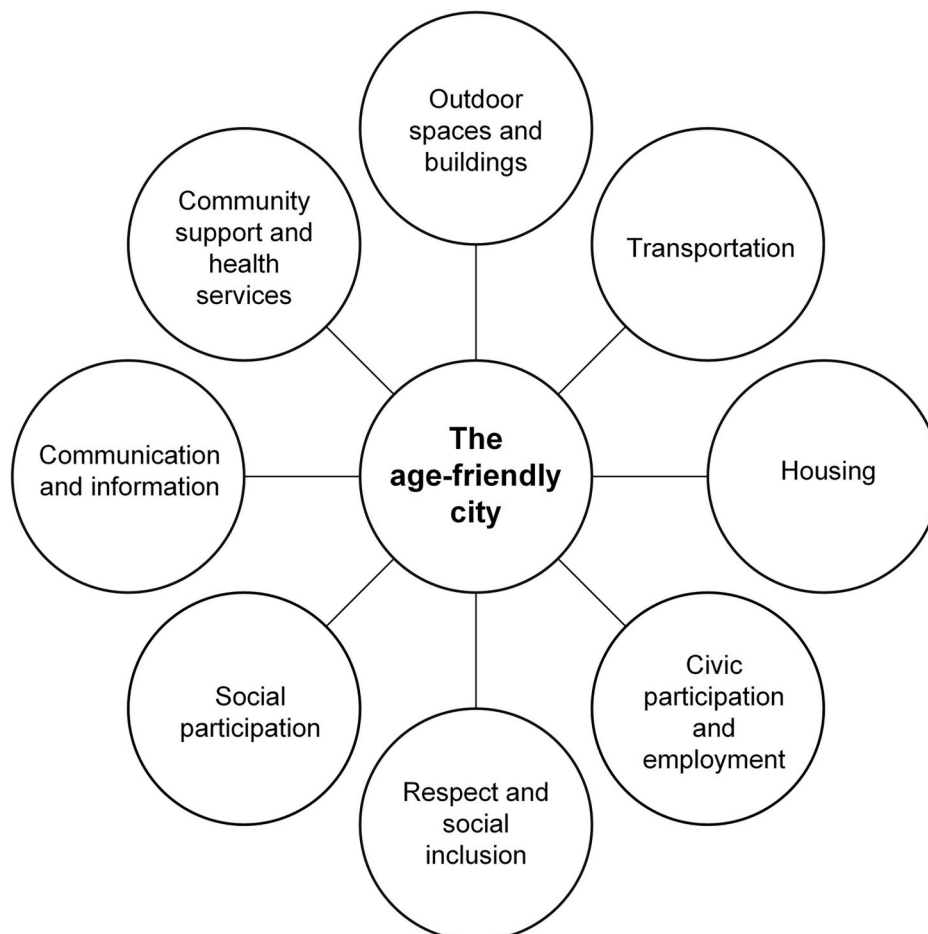


Fig. 1. The 2007 WHO model of Age-Friendly Cities [17].

upon the other domains, such as social participation (in making decisions about the built environment), respect and social inclusion as well as community support, which should be addressed in the design, operation and management of the built environment.

Building on the notion of the need for multisectoral action, Fulmer et al. [25] proposed an age-friendly ecosystem (Fig. 2). In this ecosystem, various age-friendly initiatives can create alliances and interactions in times of continued population ageing. Their vision encompasses the lived environment and social determinants of health, as well as a prevention-focused public health system and the healthcare system itself [25]. At the same time, the call by Fulmer et al. [25] was preceded by the proposition of a novel ecosystem by Marston and van Hoof [26]. They highlighted the apparent lack of contemplation of technology in the scientific and grey literature on AFCs (Fig. 3). Marston and van Hoof [26] further argue for the integration of technology in the age-friendly living environment in its broadest sense, including associated information and communication technologies, as well as its inclusion in the assessment of the age-friendliness of AFCCs.

Focusing on the built environment in the context of AFCs, Chao et al. [12] developed the Ageing Well Urban Planning Model. This model is based on the notions of a healthy city. According to Chao, several domains of the WHO Age-Friendly City Model have clear spatial requirements, such as the domains of transportation, outdoor space and buildings, and housing (Fig. 4). At the same time, it is easy to neglect the spatial needs of other social-service domains and, therefore, underestimate the corresponding urban planning approaches. For instance, the domain of civic participation and employment may need the development of community centres and fitting work environments. Spatial needs can, thus, be identified for all eight domains of the WHO model in a systematic fashion. The model shows four levels of spaces according to publicness: public, semi-public, semi-private and private spaces. Spatial scales for older people expand from an individual's home to city-level public areas, and can create friendly as well as unfriendly environments. In the words of Chao [12, p.39], *"the priority of the planning principle should be accessibility and preferably walkability between different scales, and usages should echo the core concept of ageing-in-place."* However, it is necessary to highlight that there is no single unified answer to the proper urban density as cultural aspects are too diverse [27].

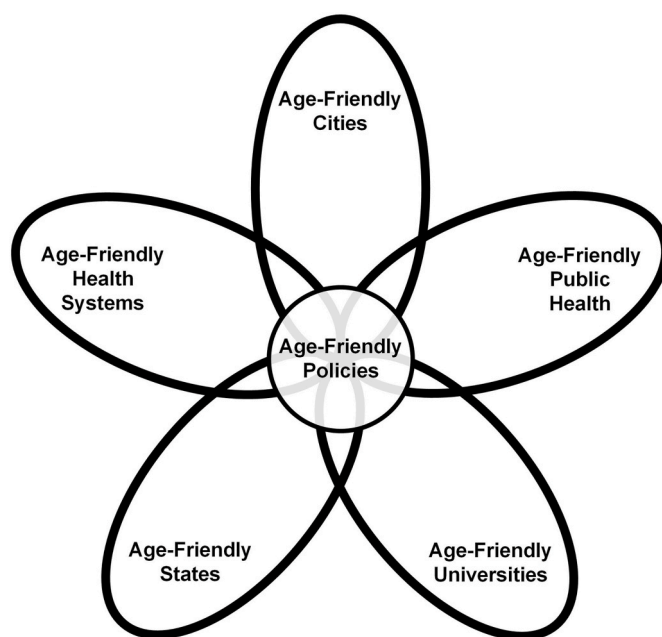


Fig. 2. The age-friendly ecosystem: a synthesis of age-friendly programmes. Taken and adapted from Fulmer et al. [25].

Marston et al. [28] proposed a new, innovative and theoretical age-friendly framework (Fig. 5) which builds on previous frameworks [26] and takes an ecology perspective. The 'Concept of Age-friendly Smart Ecologies (CASE)' framework [28] encompasses various outer and inner-spheres associated with sustainability, environmental, and accessibility factors. While technology is featured within the inner quadrants of the framework to reflect the interconnection of technology within this framework. The uniqueness of the CASE framework has the potential to represent a district or suburb within a city or town and with the eight hubs located centrally in the framework would vary (small, medium or large) based on the positive and negative impacts indicative of the respective district. For example, if public transport was well connected and services were well represented this would be illustrated by a large circle. However, if community support and health services were poorly supported and limiting, this would be illustrated by a smaller circle.

Finally, other efforts such as the aforementioned Livability Index by the AARP [29], also consider many aspects of the (built) environment. As part of its hybrid approach to Livable Communities and AFCC, the AARP produces a series of roadmap workbooks on topics such as liveability, community consultation and housing.

2.3. "Question 3: Which aspects of housing are included in age-friendly cities?"

Answer: As acknowledged by the WHO [30], housing can contribute to a plethora of positive health outcomes, particularly in light of urban growth, ageing populations and climate change. The WHO provides recommendations concerning inadequate living space, indoor temperatures, injury hazards, and accessibility [39]. Apart from accessibility, egressibility of a dwelling is important to consider [6]. In other words, can an older person lying on a stretcher be taken out of the home by paramedics in cases of emergency? Not surprisingly, housing is one of the eight domains of the AFCs' model by WHO [17]. Housing is essential to safety and well-being, and the housing structure, design, location and choice are aspects of housing that are deemed important by the WHO AFCs' guideline. In the words of WHO, there is a link between appropriate housing and access to community and social services in influencing the independence and quality of life of older people. Such enabling housing and support services for ageing comfortably and safely within the community receive ubiquitous recognition [17].

Age-friendly housing spans a wide range of housing options, ranging from mainstream housing to specialised housing and care homes [31]. A vast array of terminology goes along with these three categories of housing: first, adapted homes, lifetime homes and wheelchair home in the category of mainstream housing; second, sheltered retirement, co-housing, retirement village and extra care for the category of specialised housing; and third, dementia care home, nursing home, residential care home, and hospice for the category of care homes. The aforementioned types of homes dwelled by older people are typical of the United Kingdom, and similar types of facilities with accompanying names exist all over the world for instance, [12,32–34]. Sengers and Peine [35] reviewed over fifty pilot projects in the field of age-friendly housing in The Netherlands, France, Ireland, and Poland, which are referred to as sociotechnical experiments. Most of the innovations tested in these experimental dwellings were not primarily material or technological, but primarily social or conceptual in character [35]. The design of many of the so-called age-friendly houses follows strict guidelines that prescribe design features as level-flooring and spacious bathrooms. According to Chao [12, p. 4–5], many of the orthodox planning principles we used to take for granted and considered as universal facts are not really making sense in an ageing society. One example is the minimum living space standard to ensure living quality, but cities like Hong Kong and Tokyo show that older people can live an age-friendly life in places with very minimal floor space areas. Here, the city itself is conducive to ageing-in-place, and the actual size of the home is less relevant to independence than the urban fabric and services and

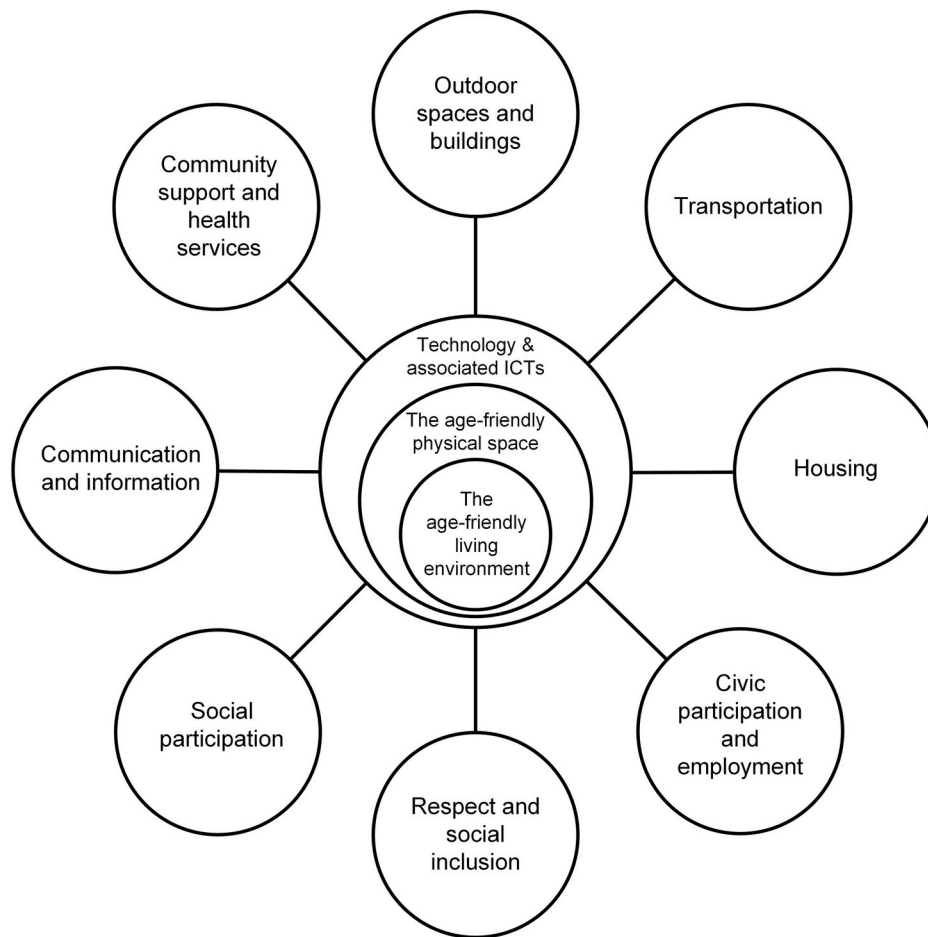


Fig. 3. The smart age-friendly ecosystem (SAfE) framework by Marston & van Hoof [26].

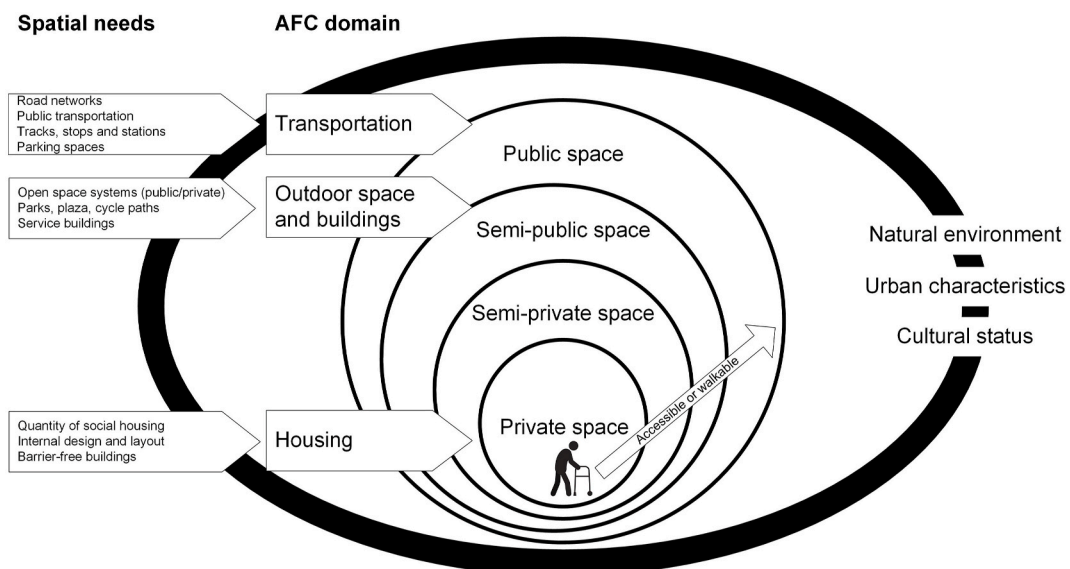


Fig. 4. The Ageing Well Urban Planning Model, showing AFC spatial needs vs. modern planning tools. Taken and adapted from Chao [12].

options on offer. Observations like this led Chao [12] to conclude that we need to pay more attention to the knowledge gap between what we think we know about older people and the reality of age-friendly design.

Therefore, the design of housing itself is another important factor. According to the WHO [17, p.31], 'it is considered important for older

people to live in accommodation that is built from adequate materials and structurally sound; has even surfaces; has an elevator if it is multi-level accommodation; has appropriate bathroom and kitchen facilities; is large enough to move about in; has adequate storage space; has passages and doorways large enough to accommodate a wheelchair; and is appropriately

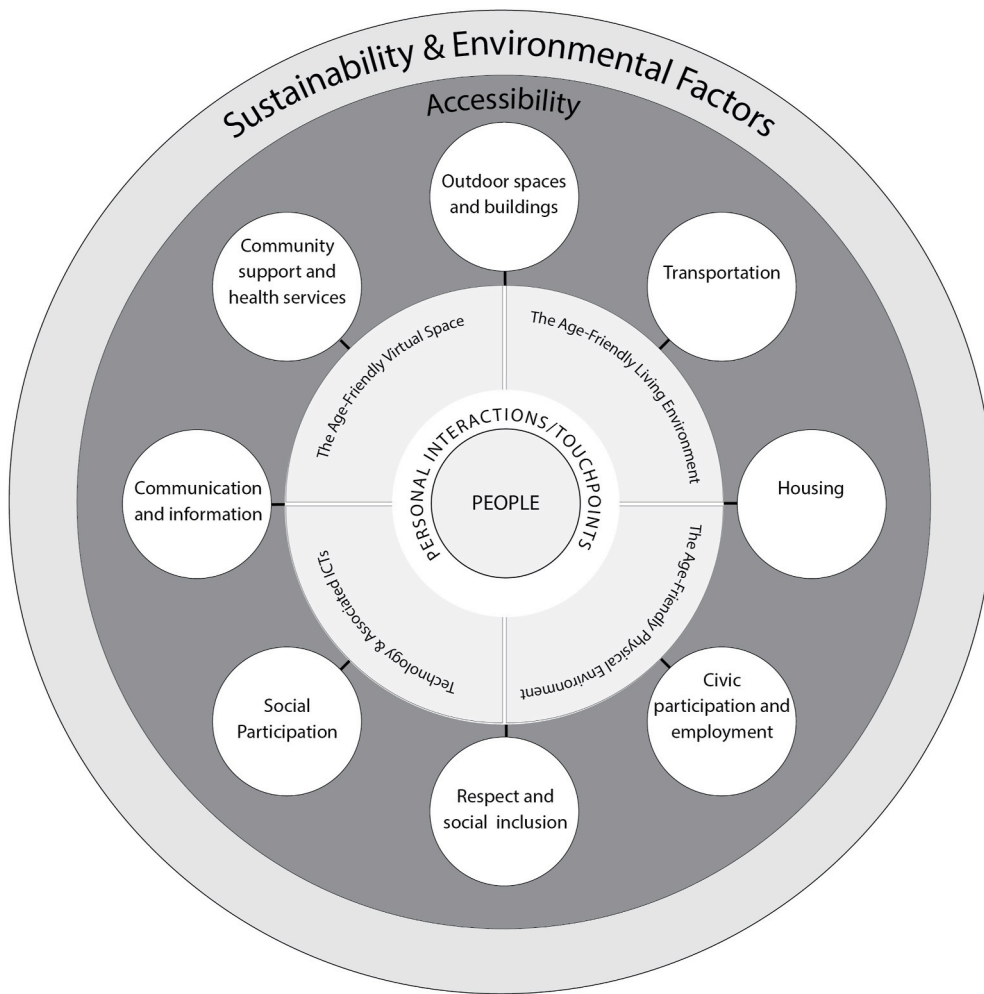


Fig. 5. The Concept of Age-friendly Smart Ecologies (CASE) framework. Taken and adapted from Marston et al. [28].

equipped to meet the ambient environmental conditions'. Given the low percentage of wheelchair users and higher rates of the use of wheeled walkers and mobility scooters, age-friendly housing should ideally be adapted for the use of such devices. Such design measures of age-friendly housing have been studied and described in great detail by various research articles, guidelines and handbooks [31,36–41]. Most of the home modifications follow the lines of national building codes and practices, as well as architectural preferences. That is why, many handbooks that are used in one country, will not be automatically suitable or transferable for use in another. The universality of “universal” design solutions is often limited, and also dictated by the availability of building components in a certain country. One way to by-pass the differences in needs and attitudes is by actively involving older people in participatory design activities of housing [42,43].

Apart from the design of housing, the WHO [17] stresses the need for home modifications, in order to provide people with the possibility to continue to live comfortably at home, when health starts to decline and a number of limitations are being posed to (instrumental) activities of daily living. A broader term is environmental interventions, which also encompass object modifications, task simplifications, assistive devices and home modifications [37]. These environmental interventions can be carried out or installed for a multitude of reasons (Fig. 6), such as alleviating the limitations posed by the loss of function or the social context, or even for positive outcomes for formal and informal carers [37,38]. In order to prevent the occurrence of stigmatisation or ageism, home modifications should only be carried out when needed, and not as a preventive strategy. The home’s design, layout, and materials used dictate the types of modifications that can be conducted in a dwelling.

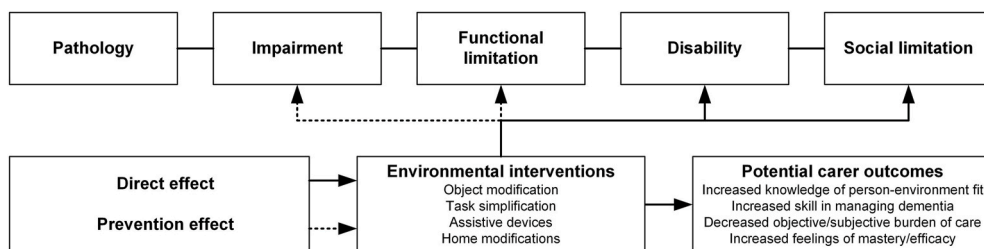


Fig. 6. Disablement model, role of home environmental interventions, and effect on carers for people with dementia, taken and adapted from Gitlin and Corcoran [44] and van Hoof et al. [37].

Apart from this, financial restrictions can pose barriers, as well as a lack of cooperation or permission to install modifications from landlords or when renting a place.

Affordable housing should be available for older people in every city, regardless of the stage of socio-economic development [16]. One of the major factors determining where older people live, their quality of life, and whether they are able to move to more appropriate housing when needed is the actual cost of housing. Connected to this, is the availability, adequacy, and affordability of essential services, such as public utility services as electricity, gas or water. An increasing number of national initiatives focus on fuel and energy poverty among older people, and improving the sustainability of housing is one of the solutions to improve the financial situation of older people [45]. Closely related to aspects of energy and fuel, are aspects as heating, cooling, lighting. These aspects of indoor environmental quality and building services engineering and their interaction with older people are described in great detail by various studies [46–52], which show that older people require different levels of lighting and have different thermal needs from their younger counterparts.

Every building requires maintenance, and so does housing for older people. For many older people, especially those with impaired health and physical limitations, maintenance can be a major barrier, which also encompasses garden maintenance. Financial barriers can pose restrictions to maintenance as well. Cleaning communal areas is an integrated part of maintenance, for which concierges and caretakers can be hired [17]. Another feature is access to and provision of services, in particular, in their own home, such as cleaning, maintenance and healthcare. In many countries, older people prefer to receive services in their own home, over moving to another home or setting. Van Hoof et al. [38] proposed the design of a home for people with dementia, and designed an additional room for a carer, and a spacious and accessible bathroom that can be utilised by a professional carer when bathing or showering an occupant with dementia. In Hong Kong, many households have a worker living in Ref. [41]. Closely linked to receiving services at home, it is important to live close to services and facilities, such as shops and, for some, religious venues.

Besides problems connected with everyday maintenance of a house, there is also an issue of architectural and technical barriers. Considering the increasing percentage of people with a disability in the post-working age group, which is approximately 40% in Poland [53], there is a need to provide easily accessible houses in order to keep these people active. Such technical amendments are needed as research shows that as people get older, there is a marked decline in one's willingness to move into an apartment which is adapted to one's mobility needs [54]. However, at the same time, the survey on household equipment (bathroom adjustments or railings along the wall) conducted with older adults shows that the majority of people who have age-friendly adjustments at their apartments do not need them, while respondents without these adjustments were more likely to assess them as needed in their houses [55]. Therefore, it is not obvious what an apartment modified to the needs of older people should look like. The possible option to this situation could be the more frequent use of solutions that fit in with the universal design concept.

Familiar surroundings and feeling part of the local community impact a city's age-friendliness positively, and contribute to a wide-felt reluctance to move. The local community itself can play an important part in creating age-friendly housing. In the case of van Hoof and Boerenfijn [56], group housing for older people was designed through the active participation and involvement of a local community in a small village in the Netherlands, that wished to keep housing for older people in the village. In complete contrast, Versey et al. [57] studied the impact of gentrification within New York neighbourhoods, and concluded that this process could even lead to gentrification-induced displacement, due to rising housing costs or the loss of the unique character and social identity of a neighbourhood. Personal preferences of older people where they wish to live are not just dictated by the price levels of housing in

urban versus more rural areas, but particularly by the social networks of people. If people nevertheless wish to move to another house in later life, it is important to have options. Having a wide span of housing choices in the neighbourhood to accommodate changing needs is recommended [17]. Too often, dedicated housing for older people is in short supply in many cities and waiting times can be long. New types of housing, including co-housing [33,34] or group living [56], may provide shelter and social interaction with like-minded older people. Such types of housing can be developed as new property, or by retrofitting existing, vacant real estate. One example from Singapore, by Chong et al. [58] is the nation's stimulus to encourage families to stay closer to each other in specifically integrated flat types, which are envisioned to promote multigenerational living and strengthen extended familial networks. As the needs of older people in terms of housing are so heterogeneous, it is obvious that new types of housing are needed in order to meet these housing needs, as well as the fulfilment of social and family needs.

Finally, feeling safe and secure in the home environment is another important domain for age-friendly housing. It is reported that some older people fear living alone [17].

2.4. "Question 4: Which aspects of transport are included in age-friendly cities?"

Answer: In the words of the WHO [17], being able to move about the city determines social and civic participation, as well as access to community and health services. The topic of transportation covers every aspect of infrastructure, equipment and service for all means of urban transportation [17]. Apart from economic and organisational factors like availability of services and information, coverage (network density and serving places older people wish to visit), safety, comfort, reliability and frequency, as well as affordability and courteous transport drivers as part of the service provision, there are factors related to the design of vehicles and infrastructure which are dealt with in this answer. These factors pertain mainly to public transportation. Apart from public transportation, older people use taxis, and there may be specialised transport services like free community transport for older people. In addition, many older people also use their own private modes of transportation, including cars and electric bicycles.

Transport planning is a key pillar of urban planning, which plays a fundamental role in responding to travel needs and logistic demands. With a focus shifting towards a more human-oriented planning, the emphasis on adequate public transport systems and user-friendly settings will have gained more attention accordingly. In an ageing society, sustainable transport planning and land use patterns can support a friendly environment for older adults to sustain their active living [12]. Loos et al. [59] reviewed older people's mobility, with a particular interest in public transport. They coined a mobility digital ecosystem framework for the evaluation of age-friendly smart transport that comprises mobility practices, digital data, networks, devices and access, as well as material and physical geographies. Their work again shows the need for an explicit consideration of technology in strategic AFC agendas.

One of the factors outlined by the WHO [17] is the availability of age-friendly vehicles, which allow for smooth boarding and disembarking from vehicles, for instance, using raised platforms or low floors, and which have priority or modified seating available. The design of transport stops and stations, as well as their location and condition, are significant features [17]. One could think about placing additional benches and shelter for people waiting for public transport, which is a feature of the outdoor space. Such benches and waste bins should not block access for people with disabilities (including users of mobility aids and people with low vision), who cannot walk around them on narrow streets. Railway stations and bus terminals should be easy to get (in)to. The premises should have an accessible design with clearly visible signage and information including the time tables [17]. People in wheelchairs or carrying luggage should be able to use lifts, especially in

train and metro stations. When designing new public transport routes, planners should consider the distance between bus stops, and plan stops close to places that are visited frequently by older people [17].

People in countries at all stages of socio-economic development report barriers to city driving [17], such as heavy traffic, poor condition of roads, ineffective traffic calming devices, inadequate street lighting and signage that is poorly positioned or obscured. Finally, there is the need for priority parking bays for older people in close proximity to a destination, together with drop-off and pick-up bays [17]. Such parking bays should be wide enough for people to get in and out of a car easily and unobstructed, like the case of the Netherlands [60], and allow for people using wheelchairs to load.

Fig. 7 shows an example of a shopping precinct in Port Macquarie, NSW, Australia, with designated parking areas for older people. Countries like the Netherlands are seeing an increase in the use of electric bicycles and mobility scooters, for which dedicated parking places are available, which also allow for charging batteries. Despite the increase in the use of such ‘e-bikes’, the physical condition of some older people may allow them to use regular bikes. However, considering the effort of older adults to cycle, there is also a need to ensure the psychological comfort connected with the width of cycle lanes, distancing cycling routes from car lanes, and preferably promote this mode of transport not only in dense city centres but also in towns and communities with slower lifestyle [61].

Alternatively, given the modes of transport described above, transportation needs of older adults may be covered also by walking. Wang and Yang [62, p. 43] define walkability as “the extent to which the built environment is friendly to people who walk, which benefits the health of residents and increases the liveability of cities”. Considering different features of a built environment, not every element can have the same impact on walkability. A literature review by Saelens and Handy [63] found that walking as a mode of transportation is often associated with higher urban density, distance to non-residential destinations, and mixed land use. Network connectivity, parks and open space, and personal safety are more ambiguous in terms of their contribution to the walkability of neighbourhoods [63]. Therefore, once the design pattern

is selected properly, urbanisation might be the factor enhancing walkability of older adults [64] and reduce unfavourable model of sedentary behaviour [65]. The walkability of older people is influenced by the older individuals’ walking behaviour, encompassing individual factors, mental health conditions, and physical capabilities, as well as by the neighbourhood walkability, which encompasses mixed land use, density (population and land use), and inclusive environmental attributes [12].

2.5. “Question 5: What aspects of outdoor spaces are included in age-friendly cities?”

Answer: There are significant ramifications of the outdoor environment and public buildings on older people’s mobility, independence and quality of life. The domain also affects older people’s ability to “age in place” [17]. Public areas often include civic outdoor spaces, but in this Question and Answer, we also include public buildings such as shopping centres, hospitals and town halls. There is a plethora of features of the urban landscape and built environment that have a positive effect on the age-friendliness of a city. A better understanding of the interaction between environment-related experiences and well-being is beneficial to achieving an age-friendly urbanism [66]. But before being able to venture outdoors, as mentioned before when discussing the concept of egressibility, older people in need to be able to leave their homes. According to the WHO [17], accessibility is an issue, such as barriers to physical access, which can discourage older people from leaving their homes. The common recommendation for addressing these concerns is education, particularly for urban planners and architects, about the needs of older people [17]. This recommendation matches with the statement by Chao [12, p.4–5], who stressed the need to pay more attention to the knowledge gap between what we think we know about older people and the reality. It leads us to an overview of what we believe constitutes an age-friendly outdoor space.

First of all, in the words of the WHO [17], a pleasant and clean environment is valued by older people, including the city’s natural surroundings. There were concerns with respect to the city’s cleanliness, outdoor noise levels and odours. One of the most commonly mentioned



Fig. 7. “Seniors parking” at Settlement City Shopping Centre in Port Macquarie, NSW, Australia. Photograph taken by Prof J. van Hoof.

age-friendly features are green spaces in a city, but sadly, there can be barriers that prevent older people from using green spaces. Such barriers include poor maintenance, littering, and perceived safety issues. There may be concerns about inadequate toilet facilities, lack of seating, and shelter from weather conditions [17]. Overall, the number of solutions is very broad in its scope.

Despite the widespread recognition of the importance accessible buildings, many (particularly older) buildings are not [17]. There are many design features that contribute to a building's accessibility or age-friendliness. These include having elevators, and, to a lesser extent, escalators, which are not accessible using wheelchairs or wheeled walkers. Other features are having ramps instead of steps or stairs, wide doorways and passages, stairs that are neither too high nor steep and that have railings, and non-slip flooring [17]. These solutions focus on mobility, and can therefore, also be beneficial for young mothers with prams and other groups of people with mobility impairments using mobility scooters and so on.

In some cities, older people are reluctant to use elevators as power outages are common and they fear being stranded [17]. In many elevators in Australia, in buildings consisting of many older people residents, there are foldable seats where people can sit down, and in the summer months, when temperatures are rising, sometimes bottles of water are provided in case an elevator breaks down. Other items mentioned by WHO [17] are having rest areas with comfortable seating, adequate signage and accessible public toilets. In a city at large, there should be increased attention for the availability of clean, conveniently located, well-signed posted, accessible toilets, for instance, in facilitating older people with incontinence. Toilet doors may be too heavy and toilet spaces too small to manoeuvre, and there may not be sufficient shelf space to chance. According to Vine et al. [67], public toilets should not only be clean but also safe to use and an integrated part of a high quality public open space. Conversely, for many citizens who have a smartphone and are visiting a new town, or city, there is the opportunity to download a toilet finder app. The Google Play store has various apps which enables Android smartphone users to review, select and install their preferred *Toilet Finder App* [68].

Many studies and recommendations focus on the public outdoor space, which is often considered to be a place to meet people. Van Melik and Pijpers [69] studied how older people use and experience public spaces as spaces of encounter in six urban ageing environments. In their study, older participants preferred commercial spaces like shopping precincts to planned and designed activity spaces in care homes or neighbourhood centres. Moreover, participants struggled with the transformations which have occurred in urban social life since they were young adults. About intergenerational contacts, older participants appreciated this type of contact, but did not necessarily want to be forced into active face-to-face interaction [70]. When postulating their thoughts about gazing through the window, Pijpers and van Melik [70] raised the issue of gazing as a subtle, yet nevertheless meaningful form of social contact, which may follow spontaneously from the design of homes and the built environment. In practice, older people are a heterogeneous group which may not share the same opinions or are faced with the same issues, as reality is complex and nuanced. Other needs may, therefore, emerge in different contexts.

The availability of seating areas is considered to be an important design element, as it is believed that the need for seating areas is great as it may be difficult for older people to go out for a walk without somewhere to rest [17]. There are many aspects related to human factors which impact the quality of seating and the ability to use seats without challenges, such as the height, the type of material and the availability of arm rests. Such features may help older people to stand up and sit down safely. We will address the issue of safety and security later, but it is often discussed among the public that other groups who may make use of these seating areas may "scare off" older people and display anti-social behaviour. Overall, there is a global need for a secure environment, regardless of the actual level of danger. Adequate street

lighting (as well as the consideration of overall lighting in parks and walkways) and surveillance cameras are considered solutions [17]. Coming back to the seating areas; not every type of urban furniture and its location might offer the same quality of experience to the users. Different materials may have a different thermal characteristic and, therefore, might be considered by users as more or less comfortable to use. Additionally, in terms of location, surrounding of trees or artificial shading objects may result in a temperature difference of neighbouring benches by approximately 20 K in the summer period [71], which may cause the situation where urban furniture is not suitable to use (for instance, due to scalding). Generally, the shared use of the outdoor spaces may pose barriers as well, and therefore, small, quieter, contained green spaces equally distributed over the city structure rather than smaller number of large busy parks used by children and skateboarders [17] may be a solution posed by urban planners.

When looking at the outdoor space, one cannot overlook the importance of the condition of pavements, which has an obvious impact on the ability to walk in the local area [17]. In the words of WHO [17, p.13], "*pavements that are narrow, uneven, cracked, have high curbs, are congested or have obstructions [such as parked cars] present potential hazards and affect the ability of older people and citizens alike to walk around*". In addition, weather conditions may exacerbate the challenges experienced by older people when using pavements [17, p.14]. Ideally, pavements have a smooth, level, non-slip surface; have a sufficient width to accommodate wheelchairs; have dropped curbs that taper off to be level with the road (also for easy access for wheelchair/walker/mobility scooter users); have clearance from obstructions such as street vendors, parked cars and trees; and there is priority of access for pedestrians. Cyclists using walkways may pose a danger to walking older people. Ideally, there should be two separated lanes or pathways – one for cyclists and one for pedestrians [17], which is often the case in The Netherlands. These technical requirements create conditions which can attract older adults to walk more often and remain active in everyday habits. As mentioned in the previous section, built environment patterns have a significant influence on walkability of citizens, and the urban structure plays an important role in order to increase it mostly by designing proper urban density, short distances to non-residential destinations, and mixed land use. Additionally, an analysis of the Active Ageing Index showed that independent living arrangements of older adults are mostly correlated with physical exercise (at least five times a week) [39,72–74], which is highly-related with the quality of outdoor spaces in neighbourhoods.

In Question 4, walkability was discussed in relationship to transportation. In this Question, we look at the needs of pedestrians from an outdoor spaces' perspective. When addressing the issues of being able to walk at ease as an older citizen, the issue of safe pedestrian crossings needs to be addressed too. There is a further need for safe pedestrian crossings, and steps to improve the conditions associated with the placement of traffic lights at pedestrian crossings, traffic islands, and even non-slip strips on such crossings [17].

Studies by Newton et al. [74] and Grant et al. [75] stressed the need for intersections with visual and auditory signalled pedestrian crossings. Such crossings should allow sufficient time for older people to cross streets. Quite common practice is to calibrate lights at the pedestrian crossings for 1.2 m/s [76], while mean walking speed of people aged over 65 years is 0.9 m/s for men and 0.8 m/s for women [77]. Despite mean values, it is important to highlight that there is a significant difference between people around 65 years old and those who are around 85. The difference in speed between these groups can reach almost 0.4 m/s [78]. Therefore, traffic lights should not change too quickly, and a visual countdown could be helpful, as well as using contactless-cards that can be tapped to allow for extra time to cross.

Davern et al. [79] identified walkability for transport and access to public open space within 400 m as priorities. These indicators are directly related to walking, and associated with physical and mental health benefits. Walkable neighbourhoods enable people to reach places

with both commercial and social opportunities, and maintain functional independence and better cognitive function. In addition, open public spaces that are easy to visit with walkable access can help reduce social isolation and increase physical activity. Future revisions of the age-friendly design principles may, therefore, consider the inclusion green and blue spaces within the WHO domain of outdoor spaces and buildings in order to address climate change. When it comes to urban greenery, which is not that influential on walkability, having existing public space in the surroundings of residential areas does not necessarily attract older adults to go walk there. Moreover, the same study shows that the proximity to urban parks may not be attractive enough if they do not include specific needs of older people in designing public spaces in urban renewal [80].

However, if the design is suitable, high quality green spaces support

social contacts between neighbours and strengthen communities for the ageing population [81]. A similar pattern can be seen in case of other attractors in urban space, which influence active ageing by a specific spatial pattern of locations of these facilities [82]. As mentioned under Question 3, Chao [12, p. 4–5] stated that in the case of the urban green space, which is a core indicator [21] for age-friendliness, it is questionable whether more green spaces will actually lead to an increased use of such areas by older people residing nearby. Nevertheless, in addition to the activity that can happen in urban green areas, they serve as an important ecosystem service connected with climate regulation. This element seems to be especially important considering that thermal stress may cause significant increase in deaths of the more vulnerable part of the society including older adults [83]. It is estimated that the heatwave in August 2003 caused up to 70,000 excess deaths in Central



Fig. 8. Displays the construction commencing in Stony Stratford, UK to widen the pavements for social distancing measures and with new markings for shoppers to stand while waiting to enter a shop on the high-street. Photographs taken by Dr H.R. Marston.

and Northern Europe [84]. This trend continued, and in 2019 vulnerable and frail populations were exposed to an additional 475 million heat-wave events globally which reflected in excess morbidity and mortality figures [85]. Over decades people were adapting to changing conditions including thermal conditions, however, the cumulative number of excess deaths during heatwaves rose due to increasing frequency and intensity of heatwaves in the last decade [86]. These external climate factors might be strengthened in the city by its structure and used materials which additionally cause urban heat island effect, where additional temperature increase can vary from 2 K to over 7 K [87]. On the other hand, urban green areas can effectively mitigate thermal stress by so-called “park cool island”. Studies conducted in different climate zones showed that depending on local conditions, it can decrease the urban temperature from 1 K up to even 6 K [88]. Based on these findings it is

possible to evaluate at the stage of urban planning how strongly a city structure may be exposed to thermal stress and create an age-friendly environment [89].

The age-friendliness of the outdoor environment is not static. It can be a dynamic phenomenon that may require immediate action based on the external context. Referring to the design of age-friendly outdoor environments in the COVID-19 pandemic, White et al. [90] have raised the issue of ‘design hacking’ and provided real scenarios/examples of how businesses and communities reacted during the early days and weeks of the lockdown in the United Kingdom. An example of ‘design hacking’ was found in the town of Stony Stratford, located in Buckinghamshire, where additional construction had taken place the high-street, in a bid to extend the pavement(s) to enable residents to queue safely (Figs. 8 and 9) and within the guidelines of the 2-m distance



Fig. 9. Displays the construction commencing in Stony Stratford, UK to widen the pavements for social distancing measures and with new markings for shoppers to stand while waiting to enter a shop on the high-street. Photographs taken by Dr H.R. Marston.

directive by the UK government for England.

Taking a semiotic perspective to Fig. 9, using this type of symbol painted on the pavement, representing feet/footwear denotes to shoppers where they need to stand. Had this been a circle, box or line markings, the signifier (meaning) may not have clearly translated to shoppers because it has not previously existed within Western culture. Similar examples illustrate how companies and services are adapting in an agile way to afford a sense of normality during the pandemic, but also assist citizens with the use of hazard markings for safety, and make a local community more age-friendly in a very short time frame.

Continuing our COVID-19 discussion, Phillips et al. [91] explore the impact the pandemic is having on highstreets and town centres across the UK, and what possibilities there are for older people/shoppers to play in reviving and rejuvenating these environments from an environmental gerontology perspective. This paper is timely not only from the standpoint of the pandemic, but it also questions the role of the WHO AFC model [17]. For example, what are the exact populations that the AFC framework is targeting, taking into account diversity and inclusivity? Agile and being dynamic is imperative to adopt change, as the pandemic is demonstrating, and this too is stressed by Phillips et al. [91, p.16], who stated that “[...] the AFC framework can be inflexible and assumes one model suits everyone (across all age ranges); it doesn't accommodate or respond to changes over time both in the environment or the person [92].” Similarly, this has been noted in another recent paper by Marston et al. [93] who examined the four Blue Zone® checklists (i.e., The Home, The Kitchen, The Bedroom, and The Tribe), which suggests alternative amendments (for instance, placing snacks into small bags, adjust the temperature in the bedroom, etc.) to citizens to enhance their environment. Their work identified strengths and weaknesses through the examination of the checklists and AFC literature. Marston et al. [93] identified large gaps in the literature and set out a proposed road map for future explorations and investigations to facilitate and propose a contemporary, and critical AFC framework(s) to reflect the respective Blue Zones®. Furthermore, implementing theoretical concepts as proposed by Phillips et al. [91] as well as understanding the various life course structures of towns and cities will empower and facilitate regional policymakers, businesses, and consumers the opportunity to feed into co-produced solutions rather than continuing a top-down approach. It is not beyond the realms of actors to identify, collaborate and propose a myriad of frameworks which encompass sustainability, agile and theoretical concepts such as ecology and environmental gerontology. One starting point is the CASE framework proposed by Marston et al. [28], which incorporates ecology theoretical concepts, as illustrated in Fig. 5, and reflects the different interconnections and associations of a district or town. Future scholars interested in taking the recommendations forward proposed by Phillips et al. [91] have an initial framework to work from, and adapt to represent the rejuvenation and revival of towns, cities and highstreets in a post-pandemic society.

2.6. “Question 6: What aspects of technology in the built environment are included in age-friendly cities?”

Answer: Technology is becoming an increasingly important domain of study relating to ageing and independence [6,26,94–101]. Older people's capability in using everyday-technology can be measured with dedicated instruments like the Everyday Technology Use Questionnaire [102]. Peek et al. [97,98] have described and modelled the complex relationships and interactions between internal and external factors influencing the technology use by older people. In contrast to popular belief, Hunsaker et al. [103] showed that “the older adult who is clueless about technology” is a myth, and some older adults serve as helpful sources of support to their peers. It shows that technology is a relevant domain to be considered in the light of AFCs. Van Hoof et al. [60] found that there are many technology-related features in the city that have an impact on the daily lives of older people. Examples include levelled access and no-cash payments in public transportation, open doors in

shops, and being able to park and charge mobility scooters [60]. Apart from facilitating factors, technological solutions can also pose barriers to older people.

A prudent evaluation and implementation of technology is essential in an AFC. Marston and van Hoof [26] discussed the integration and use of technology within the AFC agenda. Their call for action has resonated since. Pedell et al. [104] proposed that the digital, in addition to physical and social aspects, need to be considered in all domains of AFCs in order to achieve actual benefits for older adults. Reuter et al. [105] stated that the WHO's AFC initiative emerged as a response to the intersecting global trends of population ageing and urbanisation, as outlined before by Plouffe and Kalache [10], but that a third global trend, namely digitalisation, is largely overlooked. There is an obvious need to reframe the role of digital technologies within the AFC, widening the scope from accessibility towards enhancing opportunities for digital citizenship.

As stated before, the WHO [17,24] presented a limited set of features for each of its eight domains that are associated with technology, nonetheless (Table 1). During the development of the guide and checklist, there was an extensive set of scientific literature available from the interdisciplinary domain of gerontechnology [94]. Despite the matching goals [94], technology was largely ignored in the original WHO checklist. This, however, does not mean that WHO did not move its agenda forward in the years since 2007. In 2015, the WHO [21] published a set of core indicators for measuring the age-friendliness of cities. In this report, there was a set of supplementary indicators, including Internet access. Similar supplementary indicators did not make it into the final list, too. The WHO [20] stated in a subsequent report that in practical terms, age-friendly environments are also supported by technologies. Furthermore, the WHO [20] notes how technical assistance and support may be required to facilitate and support implementation. The reports can be seen as an implicit recognition of technology part of the spectrum of solutions to achieve the goals of the AFCC's movement.

Therefore, in 2019, Marston and van Hoof [26] proposed a new extension to the existing WHO age-friendly framework which they coined the term ‘*Smart age-friendly ecosystem*’ (SAFE). This ecosystem was created because the original age-friendly framework [17] did not explicitly acknowledge technology. At the time of the WHO publishing their AFC framework in 2007 technology was not included although the use of Internet, assistive technologies, and mobile/smart phone developments were continuing to grow at a phenomenal rate which is documented by international scholarly research [122–135]. Dikken et al. [136] confirmed the importance of technology in the assessment of age-friendliness, although the domain seems to be interwoven with the eight existing domains defined by the WHO. Therefore, technology can be seen as an integrated aspect of age-friendliness that has an impact in all domains of daily living. Describing the ‘*Smart age-friendly ecosystem*’ the inner circle - ‘The age-friendly living environment’ denotes the physical space of the home environment, where citizens live (such as a house or an apartment) either on their own or as a family [26]. The ‘age-friendly physical space’ segment is associated with the physical environment surrounding the ‘age-friendly living environment’ - such as the urban environment (i.e., villages, towns and cities), and include both younger and older citizens. Finally, the outer segment - ‘Technology and associated ICTs’ interconnects all technology devices, software and usability interweaving between the inner, central segments but also acts as a gatekeeper to the outer spheres [26].

Marston and van Hoof [26] did not stipulate the extent to which citizens may interact and interconnect with the varying spheres, and this may change depending on the purpose, behaviour and in different scenarios could vary several times. To date, the ‘*Smart age-friendly ecosystem*’ is the most up-to-date, and appropriate framework for use in work relating to age-friendly and technology research. However, Marston and van Hoof [26] acknowledge this framework is agile and additional iterations may be needed to reflect changes within our society, individual, local, and national ecosystems. Future interactions of the

Table 1

Technology features across the eight domains of AFCs as stated by WHO [24], taken from Marston & van Hoof [26].

Domain	Age-friendly cities essential features related to technology	Additional features
Outdoor spaces and buildings	<ul style="list-style-type: none"> · Visual & audio cues and adequate crossing times · Good street lighting · Accessible elevators, ramps. 	<p>Users can use mobile apps (mApps) to identify a range of information depending on the type of environment they are in. For example, if a person needs the toilet but this information is not visible in the physical space/ building, a toilet app installed on a smartphone will provide this information. Similarly, mApps relating to the Post Office [106] and other services, which can be found in towns and cities, could be used for citizens who require currency, or travel insurance. Installing ‘beacons’ into public spaces and buildings, detected via user’s smartphones as the person walks through a particular area, the connectivity between the beacon and the users/tourists’ smartphone can deliver various types of information. Such information would be delivered in various languages to facilitate a user-centred approach [107]. Developing, deploying and utilising a mobile app would enable users/citizens to access various information relating to transportation schedules, tracking of transport, road accidents/traffic congestion and enable users to pay for public transport.</p> <p>Taxi firms such as Uber and Skyline taxis [108] located in Milton Keynes enable users to book, pay and track via their respective Apps. If a user of Skyline taxis chooses to pay in cash, this facility is available. The fare can be split with other users, and while waiting for the taxi to arrive, the user receives regular updates: driver’s name, car registration plate and model, real time tracking, and notification of arrival. A receipt is emailed to the user. mApps specifically designed for cities and towns which have a metro/underground system (for instance, London Underground) can afford visitors, and residents the option to check a route in real time [109]. Such mApps can provide additional information relating to accessibility (such as prams, wheelchairs, luggage), station information (such as toilet facilities, cast and ticket machine, taxi ranks and WiFi). Tube Map [109] is also available via Twitter and allows citizens to keep up to date in case of accidents or delays.</p> <p>The Citymapper App [110] affords users to identify the most appropriate route and includes additional and different information to various transportation modes. A step-by-step direction can be provided. Implementing Internet of Things (IoT) devices such as sensors, and cameras within the home ecosystem as well as on the outside of a home can offer residents a greater sense of control and security. Marston and van Hoof [26] and Marston and Samuels [111] detail various IoT devices and virtual assistants which in turn illustrate the roles, tasks and responsibilities which can be deployed within the home.</p> <p>Additional IoT devices can be implemented into both the home environment and public/commercial ecosystems via devices such as coffee machines, dishwashers and washing machines [112]. Affording the owners of the devices the opportunity to record usage and, when necessary, replacements via the IoT device can be conducted.</p> <p>Employing and implementing a multifaceted approach which includes both paper-based and technological solutions can afford citizens ease of access to information relating to the various facilities and can make accessibility easier for citizens who may (not) have impairments.</p> <p>To complement existing literature, mApps can offer greater flexibility to citizens and tourists ‘on the go’ who require instant information. In the new town of Milton Keynes, there are Starship robots [113] which are self-driving robots and deliver groceries and takeaway food to different areas of Milton Keynes. Tesco’s located at Kingston were one of the first commercial businesses to sign up to the company. Marston and van Hoof [26] discuss in greater detail this technology. Furthermore, these robots offer vulnerable citizens and older adults the opportunity to receive groceries if they are unable to leave their home.</p> <p>Interweaving a ‘Big Data’ approach into a town or city can provide various services and support with insight into user/tourist behaviours. This type of analytics can provide community services, municipalities/governments the opportunity to (re)assess different service provisions and adapt for greater user engagement [114].</p> <p>Employing artificial intelligence (AI) and blockchain infrastructures into public spaces, buildings, and employment can provide citizens, residents, tourists, business/industry and municipalities/governments the opportunity for information to be streamlined between parties (such as government/ service providers). While ensuring the user experiences are positive at different levels of the ecosystem between services, agencies, industry and government municipalities [107,115–117].</p> <p>Exploring how the United Arab Emirates [118,119] are implementing technology into their cities, in a bid to offer residents and tourist of Dubai the opportunity to access and use services to enhance social engagements, activities and streamline day-to-day living; access autonomous and shared transportation services and solutions, in conjunction with quality environmental and sustainable strategies associated to residential,</p>
Transportation	<ul style="list-style-type: none"> · Vehicles · Transport stops and stations are conveniently located, accessible, safe, clean, well lit. · Accessible information to users about routes, schedules, special needs facilities · Taxis are accessible and affordable 	
Housing	<ul style="list-style-type: none"> · Home modification · Public and commercial rentals are clean, well-maintained and safe 	
Social participation	<ul style="list-style-type: none"> · Good information about activities and events is provided, including details about accessibility of facilities and transportation options for older people. 	
Respect & social inclusion	<ul style="list-style-type: none"> · None 	
Civic participation & employment	<ul style="list-style-type: none"> · None 	
Communication & information	<ul style="list-style-type: none"> · A basic, effective communication system reaches community residents of all ages. · Regular information and broadcasts of interest to older people are offered. · Printed information – including official forms, television captions and text on visual displays – has large lettering and the main ideas are shown 	

(continued on next page)

Table 1 (continued)

Domain	Age-friendly cities essential features related to technology	Additional features
Community & health services	by clear headings and bold-face type. · Print and spoken communication uses simple, familiar words in short, straightforward sentences. · Telephone answering services give instructions slowly and clearly and tell callers how to repeat the message at any time. · Electronic equipment, such as mobile telephones, radios, televisions, and bank and ticket machines, has large buttons and big lettering. · There is wide public access to computers and the Internet, at no or minimal charge, in public places such as government offices, community centres and libraries.	manufacturing, transportation, waste management. This would result in cleaner resources across the country.
	· Health and social services are conveniently located and accessible by all means of transport. · Health and community service facilities are safely constructed and fully accessible.	Many health services enable patients to book an appointment via an online website. However, there could be additional options in addition to online websites, and the telephone, and this includes a specific mobile app for the surgery or health service provider which could be downloaded from the iTunes/Google Play Store. Such an App would allow citizens to book an appointment via the calendar for a suitable time and practitioner. Developing an App for various facilities would allow citizens to seek out different types of information (for instance, opening times, specific health related information/procedures). There are various health, fitness and lifestyle Apps that can be downloaded onto a smartphone. Depending on the needs and requirements of the user - additional devices such as a Fitbit maybe needed. However, if mHealth Apps are being used in general practice enabling the health practitioner and the patient to monitor specific health concerns such as arrhythmia and palpitations [120]. Health devices which facilitate the patient to conduct a real time reading when experiencing palpitations can be conducted via a device attached to a smartphone which in turn the reading is emailed to the health practitioner in the form of a PDF document. This enables everyone to read the results and provide a diagnosis. Tailoring specific health messages and information for certain groups in society is an option that should be considered [121]. Utilising contemporary technologies such as mHealth Apps in addition to existing tailored websites and interventions has the potential to reach wider members of society.

'Smart age-friendly ecosystem' are expected to reflect the changes, developments and behaviours of citizens, industry, stakeholders, and services. The ecosystem and its application range are open to amendments. In the following sections, we present and describe various research activities associated with different mobile apps (mApps) and mobile health apps (mHealth Apps) as a means of illustrating how this type of technology has become interwoven into the built environment and the lives of citizens.

Towards the end of the first decade of the 21st century, society witnessed the introduction to mobile apps (mApps) and mobile health (mHealth) apps which have now become an integral component interwoven into the lives of many citizens. Lupton [137] notes how Apps are "designed to be media artefacts that are quick to acquire and on impulse, and just as easily discarded or relinquished" [138]. Both mApps and mHealth apps facilitate citizens to conduct various activities ranging from work related tasks (such as checking email) [139] to self-tracking and monitoring one's health [140] or seeking out companionship, sexual intimacy, and/or relationship [141]. Recent reviews of self-tracking and monitoring have included health conditions such as arrhythmia [120] while mHealth apps in conjunction with devices such as wearables (such as a smartwatch) affords citizens to track their levels of physical activity and chronic health conditions [142,143]. Furthermore, social media platforms and communication tools are available to download via online stores and installed on to respective smartphones. Thus, allowing citizens ease of access to maintain socially connected and up-to-date with news and developments. During the COVID-19 pandemic, the UK has witnessed the rollout of the 'track and trace' National Health Service (NHS) app. Citizens who have chosen to download and use this mApp are required to input certain details such as their postal code, and should they wish to go into a venue (for instance, a high-street shop), they are encouraged to scan a QR code, which in turn is inputted into the mApp and should there be a positive test reported, in the vicinity those citizens

who have recorded their visit will be notified. Additional features afford citizens the option to enter test results, access and read the latest advice. However, taking an age-friendly context, older people do not own or use a smartphone while many own a mobile phone [126,144]. At present the UK and devolved Governments (Wales, Northern Ireland and Scotland) are aiming to utilise and deploy contemporary digital technologies such as the respective Track and Tracing mApps as a means of gaining some kind of control and understanding of the COVID-19 pandemic across the UK.

These types of mApps/mHealth Apps, while accessible via a smartphone, afford users the opportunity to track, monitor and plan one's health. From the standpoint of the built environment mApps, devices coupled with sensors can be integrated into one's home [145–147]. Resulting in the resident having greater control of their home environment by a simple touch of their smartphone screen. Furthermore, interconnecting these different, but similar purpose built-sensors and mApps can provide residents to monitor, plan, track and amend energy consumption, heating and cooling and surveillance, regardless of where they are in the world (for instance, working, holiday, etc.).

Previously, Marston and van Hoof [26] described various case studies to illustrate how citizens and residents alike are implementing sensors and mApps to monitor, track, and plan their fuel consumption, home security and heating within their *individual smart age-friendly ecosystem (iSAfE)*. By integrating technology devices, sensors and switches which can be accessible via a smartphone from any location (for instance, the office, abroad, public transport etc.) has in essence transformed their home into an *individual Smart Age-friendly Ecosystem (iSAfE)*. For instance, older people are able to network and connect the temperature of their iSAfE through various wireless sensors situated throughout different rooms in their home. This affords the citizen to set and change the temperature in different rooms to suit their needs (such as, a child's bedroom, living room, etc.). Additional information is

presented to the user on the interface, detailing the weather outside. Home monitoring devices can afford citizens to conduct various social and health related activities, in addition to smart home activity. From the examples provided here and in existing research [26] it is prevalent how sensors, devices and associated technologies have moved the narrative forward relating to age-friendly and the built environment. However, from the standpoint of the UK, there is still the discussion of the digital divide and technological infrastructure that still inhibits citizens of all age groups [148–154], who are living in different physical environments (rural vs urban) [155,156], and who are experiencing digital poverty [157–160]. For many citizens the affordability of Internet access, and hardware devices is still an issue, in conjunction with poor infrastructure resulting in poor and/or limited access to the Internet in their respective area/region [161].

Additionally, in the context of the built environment of age-friendly societies, driverless vehicles the Electronics and Telecommunications Research Institute (ETRI) and the South-Korean EV manufacturer - IT Engineering have developed a piece of software accessible via the smartphone which enables the citizen to 'call' and 'move' one's autonomous vehicle (AV) via voice recognition [162]. From the standpoint of electronic vehicles (EVs) owners have the option to install Apps such as *EVNotify* [163] which allows drivers to track the charge of their EV battery. However, knowing where there are charging stations/points is important for all EV drivers and an app called *NEXTCHARGE* [164] offers drivers the opportunity to map charging stations along their (respective) specific route.

For those that have to rely on public transport there are also some technological solutions which allow to use this mode of transportation in a more convenient way. As urban traffic is a quite common problem in almost every city [165,166], issues in traffic flow obstruct punctual functioning of busses, trams, trolleybuses or any other mode of transport that has to share infrastructure with other types of vehicles. In order to avoid people waiting at a stop without information about approximate time of arrival, for example in the city of Wrocław (Poland) for a few years already there is a track and trace app to localise all vehicles of local public transport (Fig. 10). Moreover, the app contains actual information on planned traffic disruptions as well as unexpected events like accidents. The initial version was prepared in 2013 and since then it is constantly developed by a local public transport operator.

2.7. "Question 7: Which tools and instruments exist for mapping and measuring the impact of AFCC solutions on the built environment?"

Answer: Members of the Network are communities, cities or other sub-national levels of government which indicate a formal commitment to undertake a continuous process of improving the age-friendliness of their environment (Fig. 11). In this cycle of continuous improvement, engagement and understanding is created, which involves setting up committees and working groups, performing participatory assessments, creating baseline profiles and dissemination of findings, as well as gaining commitment. Consequently, according to the WHO [20], plans should be made to unite stakeholders behind a common vision, to analyse strengths and weaknesses, to develop a comprehensive strategy, get approval for plans, and define responsibilities. This initial planning stage is followed by an acting phase, involving the development and implementation of action plans as well as stakeholder consultation, securing support and resources, and scaling-up successful actions. The next phase of the cycle includes the measurement and monitoring of progress, for instance, through outcome and impact evaluations. The continuation and expansion of partnerships is also part of this phase, as well as international exchange [20].

The aforementioned Checklist of Essential Features of Age-Friendly Cities [24] can be used for the self-assessment of a city or community, and used as a map for charting progress. The set of core indicators and list of research methodologies published by the WHO [21] can also be used as additional input parameters for the assessment. Key criteria for

selecting the indicators for AFCs are measurability, validity, replicability, and sensitivity to change. Other indicators were the possibility for disaggregation of the indicator, alignment with local goals and targets, the potential link to action, the scope of the criterion (within local influence), ease of data collection and social acceptability. The ultimate goal for setting the core indicators is to advocate the priority of local older adults to ageing well, and older people need to be active participants instead of customers expecting services [12].

The WHO provided suggested definitions when using self-report data (including suggested data sources), and other comments for the core indicators. For instance, when focusing on interventions to create an age-friendly physical environment, one could focus on planning and land use; design of public spaces and buildings; housing design and cost options; and transportation design [21]. The short and medium-term changes achieved in creating an age-friendly environment would lie in the following outcomes; walkability; accessibility of public spaces, buildings and transport; affordability of housing; and safety. These outcomes, in turn, should have long-term effects on health and well-being. Among the relevant core indicators identified by the WHO are neighbourhood walkability; accessibility of public transportation vehicles and public transportation stops; accessibility of public spaces and buildings; and the affordability of housing [21]. Among the supplementary indicators, which were strong candidates for inclusion in the core indicator set, were the accessibility of priority vehicle parking; the accessibility of housing; internet access; public safety (which includes installing way-finding systems and safety features at crosswalks) and emergency preparedness [21].

The WHO also sets a number of limitations of the framework and indicators, stating that "*age-friendliness is a complex, dynamic and multi-dimensional concept which is also highly context dependent*", and that "*it does not easily lend itself to standardization of measurement*" [21, p.65]. The WHO acknowledges that dependence on the core set provides a simpler and potentially inappropriate overview of the complex reality, and that there is not a perfect correspondence between the core indicators and the eight domains of the AFC model. Finally, there is a lack of strict standardisation of operational definitions, which may lead to variations in measurement and reduced accuracy and comparability [21].

Buckner et al. [167,168] postulated that one of the challenges for the evaluation of AFCs is the identification of an evidence-based approach that reflects the contextual complexity of the initiatives. Among the thematic areas where evidence was required, the authors identified the involvement of older people; collaboration and interlinkages; and monitoring and evaluation as being important. Additionally, Chao [12] called for a more integrated research methodology in urban planning in relationship to AFCs. She stated that many new urban challenges may take place beyond our scientific analysis and projections. And adopting new methodologies from other individual-oriented research disciplines would be a timely approach, as taking the idealism path to make the utopia that might never work in reality may no longer work in the current time frame of ever-increasing speeds of urbanisation and ageing.

The lack of measurability of the actual age-friendliness of AFCCs has been a clear weakness in moving the agenda forward [136]. A wide spectrum of qualitative methodologies has been applied to measure and assess the age-friendliness of a city, often including elements of photography [60,169]. Some of the qualitative approaches concern citizen science programmes which included older adults as environmental change agents and co-designers [170,171]. One of these Australian citizen sciences approaches [172], studied public green spaces for ageing well through data collection by older people using smartphones. Other studies [173,174] applied the photovoice methodology, which enables participants to express their ideas through photographs they take themselves, followed by a semi-structured interview on the meaning of their photos. The study by Huisman and Mysyuk [174], for instance, found that older people in Amsterdam searched their living environment for tranquillity, peace, beauty, memories and

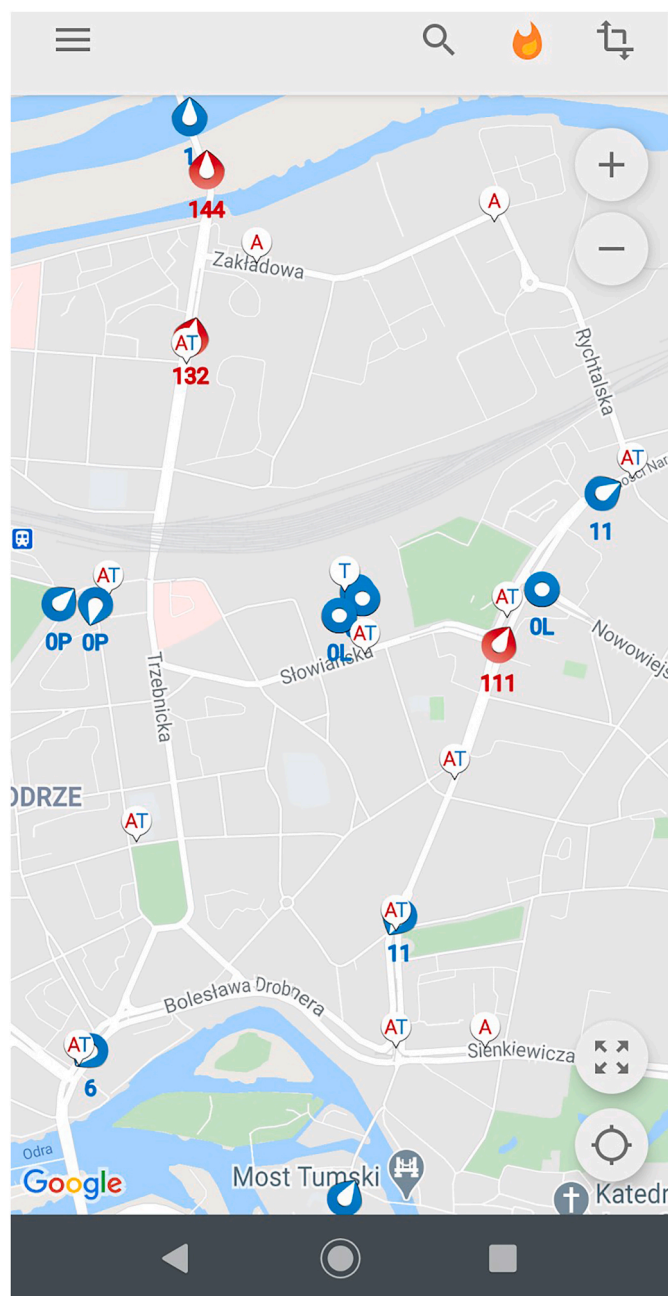


Fig. 10. Interface of mobile app to track and trace public transport vehicles in the city of Wrocław, Poland (iMPK). Screenshot by Dr J.K. Kazak.

meaning. In a similar study from The Hague, Von Faber et al. [175] employed participatory video design instead of photography and produced a series of documentaries on the perceived age-friendliness of their neighbourhood. Themes which came to the fore included communication and information, outdoor spaces, social relations, and community support. Such qualitative approaches yield rich data on the perception of the built environment, and provide an engaging research setting to participants, but largely fail in enabling a (numerical) comparison between countries, cities or neighbourhoods.

As summed up by Davern et al. [79], the age-friendly initiative was critiqued for being too descriptive in approach, not measured or monitored by indicators [176], and without a clear understanding of an indicator framework [177]. Davern et al. [79] also concluded that only after the major factors have been quantitatively evaluated should additional qualitative evaluations be conducted [79]. In line with this

statement, a large number of researchers have tried to develop quantitative approaches to assess and evaluate the age-friendliness of a city or community. These attempts were often, but not exclusively, rooted in the WHO's Checklist [24] and are presented in the following paragraphs.

For instance, Tiraphat et al. [178] examined the association between age-friendly environments and the quality of life among Thai older adults. The researchers used the Thai version of the 23-item "Neighbourhood Environment Walkability Scale-Abbreviated" (NEWS-A) [179], and a nine-item neighbourhood social environment index [180], instead of an instrument based on the WHO's checklist. In other studies, sets of priority indicators, frameworks and conceptual surveys are made, but none of them led to a validated and reproducible questionnaire or tool [181–183]. Other researchers took several further steps in their attempts.

Wong et al. [184] conducted two surveys in Hong Kong, which adopted a quantitative approach on the perceived age-friendliness. Two structured questionnaires were developed based on a local adaptation of the WHO's AFC guidelines (85 versus 50 aspects under the 8 domains). Respondents rate their responses on a 6-point Likert scale, with higher scores indicating greater age-friendliness. A later study from Hong Kong by Yu et al. [185] used a 53-item questionnaire using the same 6-point Likert scale, covering physical and social environmental domains. Gibney and Ward [186] developed a composite index for monitoring the age-friendliness of urban environments in Ireland, named the Age-friendly Urban Index (AFUI). The AFUI is a perception-based measure of safety, access to services, and walkability, which expresses the quality of the urban environment on a scale of 35 (least favourable) to 105 (most favourable) [187]. Garner and Holland [188] developed and validated their Age-friendly Environment Assessment Tool (AFEAT), which assesses whether individual function and frailty impact the perceptions of age-friendliness of the environment. The AFEAT comprises 10 items (using a 5-point Likert scale system), and is a valid and reliable tool [188]. Although the tool is based on the WHO's Checklist [24], the AFEAT does not cover all eight domains.

Whilst the instruments described above have been vital in driving forward the work on measuring 'age-friendliness', a number of issues can be identified, notably those around methodological rigour and validity, and the lack of instruments covering all domains of age-friendliness. Addressing these research gaps, Dikken et al. [136] developed the 23-item Age Friendly Cities and Communities Questionnaire (AFCCQ) for measuring age-friendliness, providing full transparency and reproducibility [136]. The AFCCQ measures older people's experiences regarding the eight domains of the WHO's AFC model, and an additional ninth domain of financial situation. The AFCCQ captures the age-friendliness numerically, and can be applied to monitor the potential impact of policies or social programmes [136].

2.8. "Question 8: What are good examples of AFCC and what can be learnt from them?"

Answer: Since the launch of the Network, over one hundred good practices have been shared in the Global Database of Age-Friendly Practices on the WHO website. These include examples from cities and communities from different parts in the world, reflecting the various domains of an AFC and their mutual interactions. For instance, there are projects aimed at improving the accessibility of the physical environment, combating ageism, increasing opportunities for social and cultural participation, as well as making policies and services more responsive to the needs of older people. However, while there is an abundance of examples of age-friendly initiatives, there has been limited research on what constitutes 'good practice', and this is further compounded by the scarcity of projects that have conducted a formal evaluation to measure the impact of age-friendly work.

This section provides an overview of age-friendly projects that have been the subject of research (for instance Refs. [3,189,190]); these were

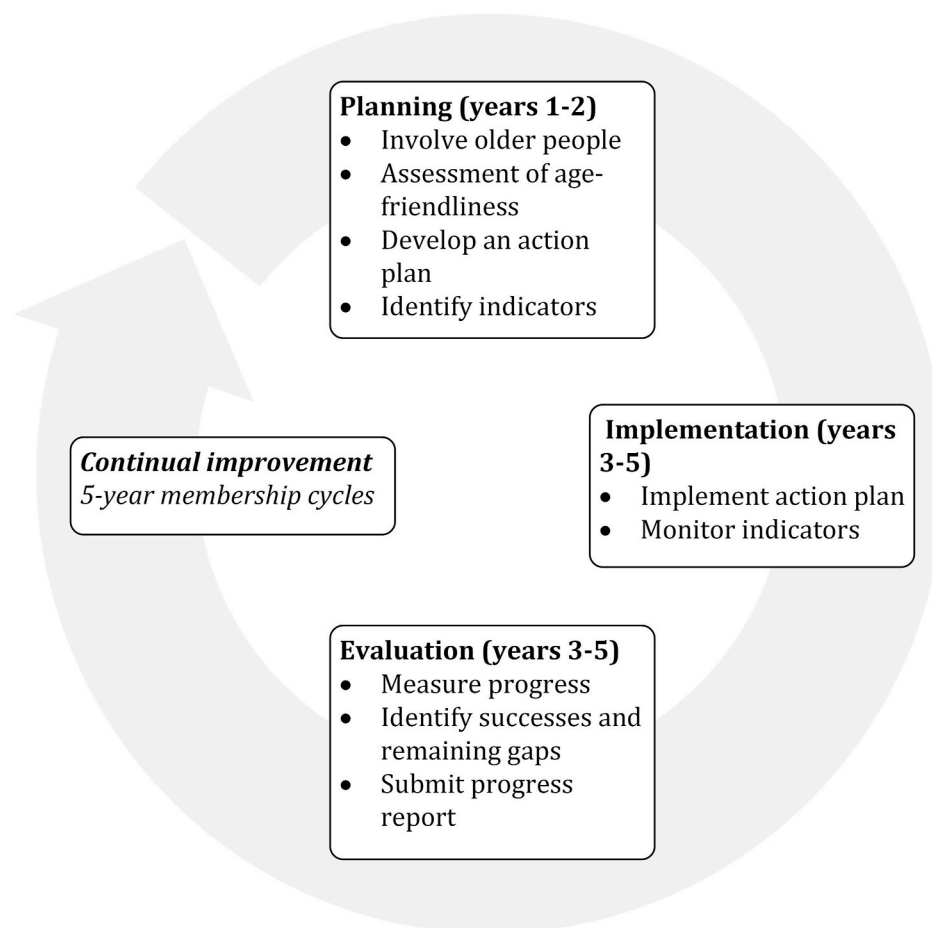


Fig. 11. The 5-year cycle of the WHO Global Network of Age-Friendly Cities.

selected to reflect diversity in age-friendly domains as well as geographical location. The consideration of geographical location stems from the maturity of the age-friendly agenda in each respective country or jurisdiction, and the accompanying needs of older people. Needs of older people in North-Western Europe are completely different from those of older people in India or Kenya, which is the result of the overall level of development, income and health, public governance, cultural practices as well as climate, to name a few. The examples that follow are not necessarily related to the built environment, but the methodologies applied can also be used to study the needs of older people in relation to housing and the built environment.

Firstly, a set of initiatives is centred around a key principle of age-friendly work, i.e., “older people must be involved at the start and at each step of the process” [20, p. 2]. Portland, Oregon, for example, has created public forums where political candidates collaboratively develop ageing policies in partnership with older adults who can voice concerns and give advice directly to decision-makers [191]. In Manchester, UK, older people contribute to the city’s age-friendliness by membership of the ‘Age-Friendly Older People’s Board’. Through their engagement, older people help develop an overall strategy for the city, and bring new priorities to the fore [20,192]. In another project, older people were actively engaged as co-researchers, and investigated and improved the age-friendliness of their Manchester communities through their commitment [171]. This project gave older people an opportunity to mobilise their experience, skills and knowledge using co-production methods as a tool for promoting social inclusion and empowerment [193]. Similar methods have been used in the Province of Quebec, Canada, where the age-friendly programme is based upon a community-building approach involving older people as key partners in

a collaborative partnership responsible for the implementation of an age-friendly action plan comprising interventions to improve the social and physical environment [194].

A second set of initiatives focuses on creating opportunities for life-long learning, which is also the focus of a recent paper by Fulmer et al. [25] on the extension of the age-friendly movement into age-friendly universities. For example, age-friendly university programmes in the USA (for instance, Arizona State University) and Ireland (Dublin City University) have been developed to emphasise the positive role of older adults in higher education as well as expand research on ageing, and create opportunities for numerous projects and activities. Research identified a number of communalities between these two programmes, highlighting the opportunities for older and younger learners to co-create experiences and mutually enrich each other’s lives [195]. In a similar vein, a successful “Elder Academy” scheme was set up in Hong Kong, to promote access to learning opportunities in educational settings for older people who had limited or no education [20]. In Poland, the initiative of “universities of the third age” became popular in the last decade. There are over 640 universities of the third age in Poland and their number is still growing [196]. In the UK, the Open University (OU) is the largest online distance education provider to provide undergraduate and postgraduate education [197,198]. The OU affords learners (young and old) to study a myriad of courses and degrees as purported by Age UK [199]. While the UK University of Third Age (U3A) is a movement that has been around for approximately 35-years, and aims to motivate and encourage older adults to continue their learning in areas that interest them [200].

Third, a range of age-friendly initiatives have been developed to promote social connections and inclusion. Since the start of the age-

friendly programme in Brussels, Belgium, diminishing social isolation has been a top priority. Six community centres were built across the city, which offer a range of social activities for older citizens free of charge [201]. In relationship to social connectedness within a local community, Liddle et al. [202] investigated the role of technology for such connectedness. According to the scholars, a thoughtful consideration of the role of technology in optimising social connections within age-friendly communities is needed, as it may even be perceived as leading to a further disconnection. Another example is from Australian café owners, which through training helped to promote a more inclusive atmosphere and which received followers throughout the country [20]. Other initiatives such as Meeting Centres Support Programmes which can be found in many countries, aim to support people diagnosed with dementia and their carers in furthering care as well as psychological rehabilitation in order to maintain their mental and social health [203]. The need for such initiatives is different in different societies, depending on the level of stigmatisation and its impact quality of life [204]. The social activities and initiatives described above take place in fitting and inviting buildings.

In direct relation to the scope of this Ten Questions contribution, a fourth set of initiatives is aimed at improving aspects of the physical environment. For example, Ottawa, Canada, has modified its outdoor environment to enable older people to keep fit and more secure and welcoming [20]. In Skerries, Ireland, older residents undertook a walkability study that subsequently informed the development of footpaths, pedestrian crossings, public seating and transport facilities [205]. A similar initiative in Manchester, UK, involving older people as co-designers of their neighbourhood including improvements to signage and the design of adapted and accessible gardens [201]. The municipality of The Hague [206], the Netherlands, has undertaken a large number of interventions in the three domains related to the built environment that may be viewed as an expression of good practice. For instance, the municipality works together with housing partners to build affordable life-time houses. There are specialist housing programmes for older people with a LGBT orientation and from ethnic minority groups. The municipality takes care of maintenance of bicycle lanes, and make sure that pavements have even surfaces. The municipality calls for co-creation between older people and planners working in order to further improve the quality of services and solutions [206].

A fifth set of initiatives, which is not directly included in the age-friendly agenda revolved around the implementation of technology, especially in the light of the COVID-19 pandemic of 2020. Since the outbreak, the pandemic has impacted citizens across society in many different ways. Intergenerational relationships were explored to understand how digital technologies play a role from this perspective [123]. This thought piece covers community and organisational actions/research at that period of time, taking a perspective of the support and behaviour of the residents of Stony Stratford, Buckinghamshire, UK who had come together via a private Facebook group in an attempt to be supportive to fellow residents in the town who are vulnerable during the unprecedented time of the pandemic. Additionally, this thought piece explores how the pandemic can impact those older adults who are ageing-without-children (AWOC) based on the work of Hadley [207,208]. From this standpoint various scholars [209–211] pontificate how digital technologies can assist older adults who are AWOC or whose children/grandchildren are geographically dispersed but who can benefit from integrating technology into their lives, building on the work of Musselwhite [212] - how important a view from a window can be for citizens.

Various approaches and best practices that have been adopted by citizens and organisation during the pandemic, to ensure some form of regular communication and routine can be maintained using online communication platforms (such as Zoom, Skype, Facetime, etc.) to meet friends and colleagues for 'drop-in sessions', 'coffee mornings', 'book clubs', and social gatherings [213]. However, technology is not a replacement for physical and face-to-face interaction. Adhering to

respective social distancing rules and regulations, one can arrange to go out for walks with friends and family members, and exercise outside. Moreover, and in association to the iSAfE [26,28] and the built environment [28,60,90,104], the research discussed here aligns to the experiences (or lack of) and opportunities of intergenerational living, community engagement and citizenship. The iSAfE framework and the built environment can differ for older adults who are AWOC, and implementing technology, and peripheral devices may provide older adults who are AWOC greater opportunities to learn new technologies, maintain connections with friends, and friendship groups more so.

Apart from the five sets of initiatives, there are some additional success factors that are identified in the research literature and which can assist in the development of age-friendly practices. Fitzgerald and Caro [214] identified the main ones as a large and growing concentration of older people, a strong network of social and civic organisations, and the availability of health and social services. These success factors were supplemented by having access to an extensive transportation network, a variety of housing options, and green and open spaces [214]. Another factor cited as important in the research literature is the extent to which cities and communities can mobilise a range of stakeholders, built around partnerships with public, private, and third sector organisations [3,194]. Linked with this is the need for strong political leadership in gaining support for age-friendly policies at local and regional levels of government [215,216]. Cultivating the existing partnerships that cities have established, maintaining political support and promoting broad-based collaboration appear to be the most critical factors to realise the potential benefits that age-friendly initiatives have to offer.

2.9. "Question 9: What are the obstacles to developing AFCC?"

Answer: Despite the many achievements, a number of barriers, challenges and obstacles to implementing AFCC programmes have also been identified, including: first, the impact of financial cuts on social programmes; second, the shift towards the privatisation of urban space; third, political barriers; and fourth, the prevalence of implicit and explicit ageist attitudes and stereotypes in the design of AFCs. Many of these barriers and obstacles are directed by a lack of knowledge and a lack of robust evidence to support choices and make informed decisions.

A first barrier concerns the impact of financial cuts to public funding. Indeed, interest in age-friendly initiatives took place at a time of economic growth with an expansion in public sector programmes, but the financial crisis of 2008 led to a significant reduction of public investment, including programmes targeting older people [217]. Many members of the Network have seen significant cuts in service provision for older people, such as the closure of libraries and leisure facilities, as well as cuts to adult education provision and home-based care. Stresses on the provision of these services have affected neighbourhoods and city-wide interventions [218]. For instance, New York City (USA) experienced a 20% loss in funding in the period between 2009 and 2012 while Manchester (UK) faced a 50% reduction in resources for its age-friendly programme between 2013 and 2015. The handling of such cuts and pressures has presented major challenges to achieving the ideals associated with building supportive communities for ageing populations.

A second obstacle to creating AFCCs relates to questions about how 'public' public spaces are, or in other words, who is in charge of and/or owns public spaces? Age-friendly policies and practices seem to make a number of implicit assumptions about ownership of, and access to, public space, including the idea that it can be shaped, controlled and designed on behalf of the changing needs of older people [3]. In reality however, private interests are often prioritised over social concerns, and the age-friendly agenda may have limited appeal to private developers, investors and companies who own big chunks of land in cities [219]. Efforts to make the built environment more conducive to the ageing population now increasingly have to work in a context of privately-owned rather than publicly-owned urban spaces. This creates

a number of challenges in terms of ensuring that urban spaces are optimal environments to support the autonomy of older people and promote equal rights to a 'share' of urban space for all [220]. One way forward could be to embed age-friendly principles into broader strategies reflecting new urban paradigm shifts to create sustainable, inclusive, smart and green cities [221]. This would require cross-sectorial collaboration and continued efforts to build bridges amongst a range of stakeholders, including public, private and third-sector organisations, as well as multiple levels of government and NGOs [4].

Third, there are a number of political barriers associated with the development of age-friendly cities and communities. There is strong evidence for instance that the success of age-friendly programmes is, to a large extent, dependent upon strong political leaders. The issue here is that changes in local leadership, along with political forces, may cause age-friendly work to fall down the priority list [214,215], with the risk of losing a whole legacy of work developed around this agenda. At the same time, work around age-friendliness has to compete with wider objectives shaping the urban policy agenda, such as those around economic development and growth, and may in consequence appear peripheral to both [222]. Age-friendly actors within cities often have only limited access to networks of power and decision-making, and budgets available to support age-friendly goals may be restricted and vulnerable to cuts to public spending. Such problems are likely to be aggravated by the relatively recent introduction of age-friendly policies in many cities, an issue which may increase their vulnerability in times of austerity. Moreover, there is a risk here that 'age-friendliness' becomes a brand attractive to cities to display their values around supporting older people, while the reality on the ground may mean continued restrictions on the quality of life of older citizens in the absence of sustained injections of resources into the age-friendly agenda.

A fourth set of challenges is related to ageism [223] in the design of AFCs. Ageism as a concept was coined by Butler [223], who referred to it as prejudice on the basis of age. A review by São José et al. [224] stresses the need to raise awareness of underexplored manifestations of ageism across sectors, such as the age-friendliness of cities [60,225] or the design of technology for older people [101]. Mannheim et al. [101] stated that exclusion of older adults from the research and design of digital technologies is too often based on a negative framing of ageing, namely in terms of frailty and incompetence. A similar trend can be found in the attempts to make cities age-friendly, for instance, when design features may actually be based on positive and negative age-stereotypes. Ageism may thus unintentionally interact with the seemingly positive age-friendly initiatives [60]. The recognition of the mere existence of ageism in the built environment and its interaction with the actual design of AFCs are unexplored domains of research. Van Hoof et al. [60] investigated whether or not ageism was manifested explicitly or implicitly in the design of The Hague as an AFC, and Zoetermeer. Older people were very visible in the city scape, but at the same time, many of the visible age-friendly solutions were targeted at impaired mobility, the need for care services and products. A consumerist approach to the visibility of ageing in the built environment, may actually lead to a fairer and more realistic image of ageing. At the same time, one could also ask oneself the question what age-friendly measures would look like if they are not targeted at older people with mobility problems, especially in the domains relating to the built environment. The study showed that more research in this domain is warranted.

2.10. "Question 10: How does the AFCC movement interact with other agendas, and what is its future agenda?"

Answer: There is a strong need to link age-friendly work with existing urban policies and movements [218]. A good point of departure would be to intensify collaboration with other movements that are also campaigning to improve urban environments, albeit in different domains. The planning and implementation of age-friendly policies can follow different pathways, depending on the country. For instance, in

Europe, local governments were in charge of the growth of age-friendly initiatives. In other countries, such as the USA, non-governmental organisations had a lead role. Partnerships with non-age-related (commercial) organisations have been limited [218]. In the words of Wetle [226], designing and implementing age-friendly communities requires long-term commitment and considerable resources. This warrants an effectual flagbearer who is successful at creating coalitions, shares a compelling vision, and provides energy and leadership to the continuing effort [226]. These initiatives may extend beyond the current borders of the age-friendly movement, covering domains such as public health and universities [25]. As we will see further on in Question 10, ideas from the smart and sustainable cities movement could also be a central part of making cities age-friendly [218].

These statements build on the outcomes of an extensive literature review by Lui et al. [227] on what makes a community age-friendly. These scholars noted a paradigm shift in the public discourse on ageing, and showed the importance of multisectoral collaboration in efforts to create inclusive age-friendly cities. Lui and colleagues [227] compared the key features of an age-friendly community as laid down in various models, distinguishing between the physical infrastructure versus the social environment, linking the WHO domains of outdoor spaces and buildings, transportation and housing to actions prescribed by British, Canadian and American entities in the domains of the built environment, housing, transportation, planning and zoning. It showed the overlap in societal and policy goals between the various entities, which all strive to create better environments for an ageing population. This in itself is not unexpected, as the age-friendly practice has steadily involved out of the public policy agenda, filtering down through actions, strategies and initiatives developed by engaged local authorities and community groups [11]. Handler [11] also states that age-friendliness offers designers and architects a powerful conceptual framework for a socially engaged urban practice.

One of the agendas that intersects with the age-friendly agenda, in particular when considering technological developments, is the smart cities agenda. Smart cities form a domain that is growing and gaining scholarly attention across different regional cities and countries. A recent paper by Ivan et al. [228] conducted a document analysis of public policy and practice on age-friendly and smart cities. To date, smart city initiatives have limited connection to the AFCs' agenda, but there is great potential for a more integrated agenda in the near future.

Marston et al. [28] provide an in-depth overview of the various concepts and technologies surrounding smart cities, which include the Internet of Things (IoTs), sensors, smart devices and apps, artificial intelligence (AI), and Blockchain. Previously, Shin [107] notes how technology has been pole position with great emphasis, while there has been a lack of understanding to the adoption of (smart) technologies. Given the inter-and-multi-disciplinary (such as gerontology, gerontechnology, human computer interaction, geography, computer sciences, ecology, planning, architecture, health and well-being) nature of AFCs, in conjunction with the phenomenal development of existing and prospective (smart) technologies, there is a need for greater reflection associated to moving the debates and narratives forward. In addition, there is a need to employ and conduct a myriad of techniques situated from these disciplines to complement and enhance these debates in a bid to capture an overall insight into adoption by citizens. Methods such as inclusive or universal design [40] as noted by Marston et al. [27] afford multiple actors the opportunity to create and implement a universal city/ecosystem; whether this is deployed across districts within cities or towns, or as a pan-city/town initiative and approach. Conversely, in terms of digital inclusion and exclusion there is the need for greater emphasis to involve end-users from the onset of any conceptual design, developments and evaluations, which also extends to other domains of design, such as the architecture of buildings [28,229]. One particular example is the 'Adapt Tech, Accessible Technology' (ATAT) project which is currently conducting a series of workshops with older adults across different sites in the UK [230]. The ATAT project is taking a

co-design and a co-production approach with end-users to understand what their needs and requirements are, in an attempt to design and develop existing and affordable technology to facilitate digital literacy and confidence by adults who are over 50-years old.

The age-friendly agenda also has the potential to intersect with the sustainability and climate changes preparedness agendas. Davern et al. [79] stated that AFC spatial indicators can be applied in a variety of international contexts, including the agendas for sustainable development which specifically mention (the needs of) older people. In addition to energy conservation and poverty [45], there is a need for a better understanding of the potential consequences of weather extremes and climate change to older communities. As postulated by van Hoof and Kazak [7], policies concerning adaptation to climate change recognise the challenges of an ageing society. The built environment is a relevant domain of the AFCs' agenda, with accessibility being a key factor. Access to sustainable energy, energy conservation programmes, and combatting fuel poverty (described under Question 3) are not. The strategic policy agendas in this field could be of value for the AFCC's programmes.

Rhoades et al. [231] studied how climate change could overwhelm older adults' adaptive capacity and highlighted the need for support services to provide safeguards. They raised specific attention for urban areas which deal with both similar climate stressors and socioeconomic conditions of the inhabitants. Van Hoof and Kazak [7] indicated how there are many potential actions in the field of adaptation to climate change and mitigating its negative effects, which also encompass local 'do-it-yourself' solutions that can be carried out by older people themselves. Such actions may play a significant role in mitigating the potential risks that environmental issues pose to older people through an improved emergency preparedness of both older people and the society as a whole [83,232]. The route of collaborative adaptation planning that engages older people with governments and other stakeholders and partners is another pathway to finding solutions [231].

AFC initiatives are underway all over world, although the majority of Network member cities can be found in high-income countries such as in Europe and North-America. Aboderin et al. [233] stated that the global AFCs' movement does not, thus far, extend to slums. A pursuit of an "age-friendly slum" effort may require modifications to the existing age-friendly framework. Another study by Tiraphat et al. [234] surveyed the perceived age-friendly environments among older citizens in Japan, Malaysia, Myanmar, Vietnam and Thailand. Perceived inadequacies were the highest among Myanmar and Vietnamese older people. The study showed that countries in various stages of socio-economic development also have different levels of perceived (and implicitly, maturity of) age-friendliness. A dedicated age-friendly agenda for the low-income countries, taking into account local challenges and preferences, may, therefore, be needed. This also implies a dedicated agenda for high- and middle-income countries. In addition, other special ageing people and communities may require their own set of age-friendly measures, such as older prisoners during and after incarceration [235].

In conclusion, a recent paper by Rémillard-Boilard et al. [236] identified four priorities the age-friendly movement should consider to expand its development. First of all, the perception of older age needs to change. Second, key actors in age-friendly efforts need to be involved. Third, there is the need to respond to the (diverse) needs of older people. And fourth, the planning and delivery of age-friendly programmes need to be improved. These four conclusions carry implications for both research and policy in the field of AFCC. Such a great leap forward can only be made if verifiable data is available on the progress of the age-friendly initiatives and making evidence-informed policies, for instance, through measuring the progress in both qualitative and quantitative ways and by interdisciplinary and multisectoral collaboration [136,237].

3. Summary and conclusions

In our answer to the Ten Questions, we have provided an outline of the history of the age-friendly movement, and shown its implications for the built environment, in relation to housing, transport and the outdoor environment, as well as technology. Thereafter we have provided an overview of how to measure and assess the age-friendliness of cities and communities. This was followed by best practices and learning points, as well as barriers to the age-friendly agenda. In conclusion, we took a closer look at future perspectives and the agenda for the age-friendly movement.

This Ten Questions contribution has shown the impact of nearly two decades of age-friendly initiatives on a global scale. Many cities and communities, albeit mainly in high income countries, have benefitted from the planning, implementation and evaluation cycle of the AFCs' agenda. However, this does not mean that the work is done. Actually, the work is far from over. It is time for practitioners, designers and planners in the field of the built environment to become engaged and contribute to an age-friendly environment within their specific domains. This work should ideally follow a life-course perspective, and require the collaboration between various sectors, including commerce.

On a global scale, an overhauled model of AFCs is needed.

The digitalisation of our societies has not been properly included in the existing models and guidelines, which is a missed opportunity to make the agenda more quintessential. Also, in order to make the models more inclusive, dedicated actions are needed for low- and middle-income countries which lack the financial and other means to make changes in society, or for which the current agenda is too avant-garde and many steps removed from the current status-quo in their respective countries.

High-income countries which are front runners in the age-friendly domain, may also need an updated agenda and related models in order to maintain their pole position, and serve as best practices for the rest of the world. Apart from such dedicated agendas based on various levels of economic and societal development, a higher degree of integration with other agendas may be desired to move the age-friendly narrative forward, such as in terms of smart cities (inclusion of technology in the age-friendly agenda) and in terms of sustainability, which is becoming an ever-increasing focal point in the domain of the built environment.

As noted previously, future planning and rollouts of research projects should consider existing digital skills and literacy levels of all end-users in society and recognise what impact digital exclusion can have on individuals, grassroot networks and communities especially when services are integrating digital formats as the primary go-to option. Future roll outs should avoid the notion of tokenism and this could be avoided by forming new partnerships with organisations from the third sector in areas and regions where there are variable levels of socioeconomic status among citizens. Future research projects should consider involving various intersectionalities rather than just age, and gender. This itself would provide greater understanding and richness to data collections, project outputs, public engagement, and knowledge transfer activities – but more importantly it would demonstrate to the organisations and the individuals the seriousness and the real need for change and voices to be heard. Finally, multi- and transdisciplinary teams have the opportunity to conduct impactful work that can be replicated in other towns, cities, and communities which may have not being recruited. Employing a co-design, and co-production approach from the onset affords everyone the opportunity to learn and share knowledge and experiences to make greater strides and lasting legacies – both from the standpoint of the individual as well as at a municipality level.

Recent efforts have led to instruments for measuring the age-friendliness of a city or community. Such quantitative and qualitative tools can help gather data, and these data are indispensable for making evidence-informed decisions and policies. Based on actual data, programmes can be enhanced, improved and scaled-up (or scaled down). It

may also help identify best practices, that can in turn be shared with the wider global community. The assessment of AFCs, as well as the creation of new action plans, should, as the WHO has postulated in various documents, be conducted in collaboration with older citizens. In the end, it is people residing in particular communities who are a large part of the degree of success of age-friendly plans and programmes. Without their dedication and involvement, an age-friendly world will be nothing more than a mere promise, and age-friendly actions of policy makers will be largely tokenistic, and new models and frameworks outdated upon their release.

In line with the Ten Questions, we propose the following ten steps to achieve an age-friendly cognizant environment:

- 1) Promote cross-sectorial collaboration and include partners from various industries and organisations (i.e., municipalities, architects, urban planners and designers, computer scientists, business/industry, gerontechnologists, transport specialists, geographers), needed to leverage change.
- 2) Co-create programmes, projects, events, campaigns, and initiatives for different target groups (involve partners in co-creation), which in turn result in action plans and route maps facilitating transparency, noting the objectives, tasks and goals completed.
- 3) Explore the opportunities for retrofitting housing with affordable technology as well as including appropriate technologies into new housing construction developments. Consider plans for intergenerational living and activities.
- 4) Understand the features pertaining to age-friendly and unfriendly environments across different age-cohorts at a local level, to develop a baseline assessment in a collaborative way, thus resulting in the identification and prioritisation of a strategy or strategies involving actions and key goals for moving developments forward.
- 5) Future strategies and route planning should be inclusive from the onset and take a life-course perspective, target audiences and groups.
- 6) Outdoor space (i.e., clean from litter, broken glass, and other implements) should be accessible (i.e., wheelchair users, people with mobility and disabilities) and safe and secure. Such spaces should include various apparatuses and green space to encourage physical activity. Outdoor spaces identified for redesign should include appropriate (access to) seating and well-designed pavements suitable for all citizens, who are walking through the respective environment.
- 7) Provision of internet access should be accessible throughout all environments enabling citizens to use mobile apps to identify key areas (such as, public toilets, transport links and EV charging).
- 8) Involve citizens from various socio-economic statuses and diverse ethnic backgrounds to ensure all voices are heard and included in future planning and decision making.
- 9) Measuring and quantifying the extent of existing and future AFCCs is key for moving the narrative forward. Employing a citizen science approach alongside quantifiable measures will provide all interested partners and collaborators the opportunities and areas that really need focus and improvement.
- 10) Consider whether existing standards and classifications of AFCCs are outdated and renew standards to meet 21st century expectations and challenges, ensuring agile approaches can be applied in conjunction with applied needs and considerations.

This Ten Questions contribution extends a hand to all people working in the domain of the built environment to work on creating an age-friendly world we all live (and hope to grow old) in.

Declaration of competing interest

Concerning their submission to Building and Environment, the

authors declare no conflict of interest.

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